SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JULY, 1928.

GENERAL PHYSICS.

1786. Applications of Technical Alternating Currents to Measurements of Short Times. O. Devik. *Phys. Zeits.* 29. *pp.* 228–232, *April* 15, 1928.

The author describes three pieces of apparatus intended primarily for lecture demonstrations to illustrate respectively measurements of large accelerations, angular accelerations, moments of inertia and the phase difference between current and voltage in an alternating current. The time measurement is obtained by passing an alternating current between a cylinder on which is a strip of paper soaked with NaI, a contact sliding over the paper. A series of lines indicates the release of I by electrolytic action. With a frequency of 50, time intervals of 0·01 sec. can be measured readily. R. S. R.

1787. Optical Tensiometer (Penumbra System). *Rev. d'Optique,* 7. *pp.* 79–83, *Feb.*, 1928.

Two methods are mentioned, due to the Hermagis Society, by which the tension of cables, wires, etc., may be measured: (1) The period of vibration of the cable is found and the tension deduced from a knowledge of the moment of inertia, density and elasticity; (2) a force is applied transversely to the wire midway between two fixed supports and the tension deduced from the resulting displacement. The second method is simpler, and in the apparatus described the force is applied by a well-annealed block of glass. Under compression the glass is birefringent to an amount proportional to the applied force. Light passes through a Nicol prism, and the glass block produces elliptical polarisation, the axes of the ellipse being measured by a compensator and analyser. The birefringence is thus deduced and from this the tension in the wire. Very small forces only need be applied, and consequently the tension in the wire is only slightly altered. R. S. R.

1788. Viscosity of Mercury. S. Erk. *Zeits. f. Phys.* 47. 11–12. *pp.* 886–894, 1928.

The fact that mercury is a non-wetting fluid and that, therefore, slip may take place at the solid boundary has led to widely divergent values for its viscosity as obtained by the Poiseuille method. The author has collected all the available data on the subject, and has derived a formula and interpolation table giving the most probable value of the viscosity between − 20° C. and + 340° C. The conclusion is drawn that in the recent measurements of Tammann and Hinnüber a slipping of the mercury, as assumed by these investigators, could not have taken place. W. S. S.

1789. Some Physical Properties of Gas-Freed Sulphur. C. C. Farr and D. B. Macleod. *Roy. Soc., Proc.* 118. *pp.* 534–541, *April* 2, 1928.

The physical properties of sulphur are shown to depend in a marked degree on minute traces of impurity. By means of a series of five distillations under CO_2 and three *in vacuo*, with no exposure to air during the process, the authors have prepared sulphur of such purity that the viscosity of the melted substance had definite fixed values at different temperatures. The apparatus was of glass with sealed joints, and the two pipette bulbs joined together, which formed the viscometer, were connected up to the distillation bulbs, so that the sulphur was transferred to them *in vacuo*, after which they were sealed off from the rest of the apparatus and the time of flow of the liquid sulphur was measured, at different temperatures, in an electrically heated bath. The viscosity of the pure sulphur is independent of the previous heat treatment, which is not the case when there are traces of gas or other impurities; values ranging in the proportion of one to eight are then obtained in some cases at the same temperature. "Mother-of-pearl" sulphur (S_{III}) separates out with great ease from the purified sulphur. The melting point of this form has been studied; the method is described, and the ideal melting point of S_{III}, the temperature at which the sulphur just begins to melt after it has been totally crystallised, is very near 107° C., practically the same as Smith and Carson's value of 106·8 C. The natural freezing point of monoclinic sulphur was found to be 114·6° C. Melting points corresponding to rhombic sulphur could not be obtained with the purified material. H. N. A.

1790. Studies in Adhesion. Part III. Mixtures of Two Lubricants. Millicent Nottage. *Roy. Soc., Proc.* 118. *pp.* 607–616, *April* 2, 1928.

The procedure is the same as that described in recent papers [see Abstracts 23 (1927) and 1444 (1928)]. Three pairs of substances have been tested, namely, (1) palmitic acid and $C_{30}H_{62}$, which do not react chemically; (2) palmitic acid and cetyl alcohol, which do react; (3) the paraffin $C_{30}H_{62}$ and the ring compound phenanthrene. Measurements are made of the adhesion, the melting point, and the "latent period," during which the adhesion either increases or decreases. The structure of the crystalline plates, which varies with composition, is illustrated by photographs. In the curves given, melting points and adhesion are plotted against molecular composition, and it is shown, for example, that for mixtures of palmitic acid and $C_{30}H_{62}$ both the adhesion and melting-point curves show a well-defined transition point when the mixture contains 3 molecules of palmitic acid to 1 molecule of paraffin. T. B.

1791. Theory of Heavy Masses Submitted to Under-Pressure, and Its Application to the Stability of Dams. J. Mesnager and note by E. Baticle. *Comptes Rendus*, 186. *pp.* 845–848, *March* 26, 1928.

The way in which Baticle [see Abstract 1471 (1928)] introduces the effect of the under-pressure into his equations is criticised, and this leads to different boundary conditions on the water face. In a complementary note Baticle accepts the correction. W. G. B.

1792. Representation of Hydrodynamic Forces. H. Heuer. *Phys. Zeits.* 29. *pp.* 225–228, *April* 15, 1928.

Mathematical. Vector formulæ are given for the general motion of a viscous incompressible fluid. W. G. B.

1793. Stream-Line Motion of a Fluid in a Curved Pipe. (Second Paper.) W. R. Dean. *Phil. Mag.* 5. *pp.* 673–695, *April,* 1928.

A first approximation to the solution of the equations of steady flow of an incompressible viscous fluid through a pipe of circular cross-section, coiled into a circle, failed to show that the relation between flow and pressure gradient depends upon the curvature. The analysis of the present paper represents a fourth approximation. From the results, the apparent increase of viscosity with flux, found by Grindley and Gibson, is shown to be due to the curvature, and begins to be appreciable at the right value of the Reynolds number. Good agreement is also shown by the theory and the experiments of Eustice. Eustice's observation that there is no marked critical velocity for flow in curved pipes is also explained, for lateral movement is present in a curved pipe at small speeds of flow, so that there is not such a marked change of flow type when turbulence sets in. W. G. B.

1794. Fluid Resistance to Moving Spheres. R. G. Lunnon. *Roy. Soc., Proc.* 118. *pp.* 680–694, *April* 2, 1928.

A description is given of experimental determinations of the time of fall in water of spheres of steel, bronze and lead up to 5 cm. in diameter for distances up to 200 cm. The results show that the law of resistance deviates only slightly (although regularly) from that expressed by the formula $F = av^2 + b\left(\frac{dv}{dt}\right)$; here b is the "carried mass." The "carried mass" does not bear a constant ratio to the mass of water displaced, but for all three kinds of spheres there is a close proportionality between b and the square of the sphere diameter, the factor being nearly unity. For small spheres b is twice the displaced mass and for 1¼-in. spheres the ratio is one-half. The resistance coefficient is plotted against the Reynolds number, and the experimental points for the spheres of all three materials are found to lie on the same smooth curve. This curve is in good agreement with Wieselberger's results. The Ladenburg correction for the influence of cylindrical walls is inapplicable for values of the Reynolds number exceeding 1000, and some experiments are described in which the effect is evaluated for this range. The paper concludes with a description of the fluid motion round about a falling sphere. [See also Abstract 1223 (1926).] W. S. S.

1795. Relation between the Coefficients of Thermal Expansion and of Compressibility in Liquids. V. S. Vrkljan. *Zeits. f. Phys.* 48. 1–2. *pp.* 111–117, 1928.

The author's previous relations between these coefficients [see Abstract 2237 (1926)] can be much simplified by means of an alteration in the definitions of the coefficients of expansion which is given in the present paper. In spite of this simplification, the applicability of the new relation, using approximations for the coefficients of expansion and compressibility, is considerably greater than that of the original relation. Two tables give the mean coefficients of expansion for the temperature interval 20° to 80° C. at two different pressures, generally 1 and 12,000 kg./cm.^{2}, and of mean compressibility for different pressure intervals at the two temperatures 20° and 80°, as calculated from the new formulæ for a number of liquids. The general formula for the maximum density of water and of some solutions is deduced. H. N. A.

1796. Sign Conventions Applied to Flexing Problems. W. H. Brooks. *Phil. Mag.* 5. *pp.* 749–756, *April*, 1928.

1797. Case of the Equilibrium of a Hollow Elastic Cylinder. Belzecki. *Comptes Rendus*, 186. *pp.* 732–734, *March* 19, 1928.

It is shown that in a hollow elastic cylinder, if the rotations and the dilatation are all zero, the cylinder must be compressed by forces applied to the ends and by tangential forces applied to the cylindrical surfaces. W. G. B.

1798. Deformation of Granular Solids. P. G. Nutting. *Washington Acad. Sci., J.* 18. *pp.* 123–126, *March* 4, 1928.

W. W. Rubey's geological data led to a simple formula, and by integration a new deformation function of wide applicability is obtained which is capable of representing the deformation of bodies possessing elastic, plastic and viscous properties all at the same time. Well borings in compacted granular material of fairly uniform density gave the relation depth × void ratio = constant within the limits of measurement, erosion being allowed for, and the function obtained can be expressed in the form of an equation of state:

$$\left[p + \frac{c}{v_g}\log\left(1 - \frac{v_g}{v}\right)\right][v - v_g] = c.$$

For very large pressures, v_g (the volume of the grains) approaches v, *i.e.*, the granular material approaches a solid whose density is the grain density. The geometrical form of the function is shown, and these curves closely resemble those observed in the shear of very viscous fluids in the relation between pressure and shear. R. S. R.

1799. Griffith Theory of Fracture. G. Horowitz and B. Pines. *Zeits. f. Phys.* 47. 11–12. *pp.* 904–911, 1928.

The authors first determine the error in the value of the energy of distortion calculated by Wolf, and a new method is supplied to account for the change of the energy of a body with change in the surface of fracture. The conditions for the occurrence of the fracture are (1) that of Griffith, and (2) exceeding the theoretical strength at least at one part of the fissure provided the fracture proceeds. The case of a narrow elliptical fracture is investigated, and the case of a tension equal in all directions or in one direction (perpendicular to the plane of fracture). The strength is in both cases the same, and is given by the formula $p_f = \sqrt{2E\alpha/\pi\lambda}$. R. S. R.

1800. Internal Stresses in Metallic Cylinders. Portevin. *Comptes Rendus*, 186. *pp.* 939–941, *April* 2, 1928.

The internal stresses of metallic cylinders have been determined by measuring the deformation when successive layers are removed. Heyn and Bauer have given a mathematical expression for reducing the observations which has been corrected by Mesnager. In this paper graphical charts of the stresses in actual experimental cylinders are shown, using the two methods. The general distribution is very similar, the stresses given by Mesnager's formula being about 30 % higher. A. Wh.

1801. Bending of a Centrally Loaded Isotropic Rectangular Plate Supported at Two Opposite Edges. A. E. H. Love. *Roy. Soc., Proc.* 118. *pp.* 427–440, *April* 2, 1928.

Mathematical. A new method, depending in part upon conformal transformation, is used, and the deflection of a plate supported at all four edges is worked out as a preliminary. Figures are given showing that the application of the bar formula gives an error in the neighbourhood of 2 %, and depending upon Poisson's ratio, in the value of Young's modulus inferred from experiments on plates whose width is one-quarter of their length. W. G. B.

1802. Completely Stable Periodic Solutions. G. Vranceanu. *Comptes Rendus,* 186. *pp.* 626–628, *March* 5, 1928.

The author deals with a class of periodic solutions having zero multipliers and whose complete trigonometrical stability is recognised at once. Certain periodic solutions of non-holonomous systems belong to this class. The paper is wholly mathematical. R. S. R.

1803. Periodic Solutions with Very Long Periods. G. Vranceanu. *Comptes Rendus,* 186. *pp.* 731–732, *March* 19, 1928.

If, in the motion near a point of equilibrium of a system with two degrees of freedom, terms below the fourth order in the potential energy vanish, periodic solutions exist, but the period becomes infinitely great as the initial displacement becomes zero. W. G. B.

1804. Crystal Structure of Paranitrotoluene. B. N. Sreenivasaiah. *Indian Journ. Phys.* 2. *pp.* 151–166, *Jan.,* 1928.

Powder and Laue photographs were taken of crystals from benzene solution. The space group is fixed as $2Di - 1(Qh')$ with 8 molecules per unit cell whose edges are: $a = 10{\cdot}1$ Å.U.; $b = 11{\cdot}18$ Å.U.; $c = 12{\cdot}3$ Å.U. A model of the molecule is shown in the original. J. E.

1805. Characteristic Differences between the Motion of a Belt at the Beginning and End of Contact with the Pulley. R. Swyngedauw. *Comptes Rendus,* 186. *pp.* 843–845, *March* 26, 1928.

The phenomena in rolling are practically the same whether the pulley is driver or driven, but in unrolling, the velocity of the outer layer relative to the pulley is sensibly greater for the driven pulley. In rolling, the difference of velocity between outer and inner layers is almost all produced after contact; in unrolling, about half the total occurs before contact ceases. W. G. B.

1806. Arrangement of the Micro-Crystals in Sublimed Zinc and Cadmium. T. Yamamoto. *Kyoto Coll. Sci., Mem.* 11. *pp.* 39–41, *Jan.,* 1928.

By means of X-ray analysis the arrangement of the crystals in sublimed zinc and cadmium was investigated. The diffraction patterns obtained indicated that the portions of the metals which were supposed to be a single crystal were not really such a simple structure. F. J. B.

1807. Twin Formation in Zinc Crystals under Tensile Stress. E. Schmid and G. Wassermann. *Zeits. f. Phys.* 48. 5–6. *pp.* 370–383, 1928.

In the elongation of zinc crystals under tensile stress the hexagonal basal plane is the slip plane [see Mark, Polányi and Schmid, Abstract 991 (1923)] and the direction of the translation is the digonal axis of favourable orientation. This main extension is followed by an after-elongation which takes place in steps under load diminution and is accompanied by audible cracks. The crystal contracts and flattens out to a strip at right angles to the main extension, and the fractured specimen shows two further slip planes of the orientation of prismatic faces of the first order; these were considered decisive for the after-elongation. This interpretation of the phenomena was questioned in 1927 by Mathewson and Phillips, who suggested a twin formation by shear stress, the twinning plane being $(10\overline{1}\overline{2})$, as assumed by Mügge in 1889. This plane would only differ by 4° 5′ from the basal plane. After renewed microscopical and X-ray tests, fully illustrated, the authors accept this suggestion. Before the contraction becomes visible under the microscope, a cross band is seen to form with helical boundaries. Laue radiograms, taken inside and outside this band, which subsequently flattens out, indicate entirely different inclinations of the basal plane. The mechanical twinning was always limited to a few strips. The length of the twin crystals did not exceed 3 mm., and they cannot have much influence on the plastic deformation. Their importance for the strengthening of the metal is discussed after Haase and Schmid [see Abstract 2222 (1925)], and the shear stresses are calculated after Johnsen. The shear-strengthening increases first slowly and steadily, then suddenly to a greater extent during the twinning period, and falls off slightly afterwards. H. B.

1808. Recrystallisation of 80 : 20 Silver-Copper Alloy. R. Glocker and H. Widmann. *Zeits. f. Metallkunde,* 20. *pp.* 129–131, *April,* 1928.

The two very pure metals are fused together, and specimens are rolled down by 98 % to strips, 10 mm. wide, 0·1 mm. thick. The alloy is much harder than either metal [see Abstract 257 (1928)]. The breaking strength is 90 kg./mm.^{2} (Ag about 40, Cu 50), but diminishes to 30 kg. at 800° C. The elongation of the alloy only becomes noticeable above 300°, but approaches that of Ag (20 %) at 800° C. Whilst, however, the softening of the silver is almost limited to a range of 20° C., the range in the alloy lies between 200° and 700° C. The experiments are made, at 0·1 mm. Hg, in a tubular vacuum furnace, consisting of a Berlin porcelain H66 tube, 70 cm. long, 4 cm. diameter, only 45 cm. of which are heated by silit rods; by tilting the furnace the specimen in its boat is made to slide into the cool portion. Mixed crystals, embedded in the eutectic and richer in copper, are brought out by etching with tetraminocupric chloride only when the specimen has been heated nearly to its melting point. Even heating for hours to 780° C. shows only a few of these crystals because the grains are smaller than $2\,\mu$; at 800° C. the grains may be five times larger, but they show no orientation. Special X-ray tests are made in a Debye camera of the Dehlinger form, in which the rays pass through two diaphragms and a thin-walled platinum cylinder in order to protect the central spot. Up to 400° C. the arcs of the extreme ring (nearly 180° from the centre) appear as broad bands; then the ring shows the two sharp lines of the Kα doublet, the first indication of recrystallisation. Unless the specimen be heated for hours above 780° C., the X-rays give the typical diagram of rolled silver. Under the microscope new nuclei begin to appear after heating to 500° C. H. B.

1809. Study of Cellulose and Its Acetates by Means of X-Rays. J. J. Trillat. *Comptes Rendus,* 186. *pp.* 859–861, *March* 26, 1928.

Cellulose gives a feeble fibrous crystalline diagram. Lines have been observed corresponding to very small lattice distances (of the order 1·2 Å.), which the author considers due to the regularity of the arrangement of the carbon atoms in the hexose groups. Other cellulose compounds were examined. The fibrous acetates of cellulose show a distinct crystalline portion dispersed in an amorphous phase. When they are dissolved, and converted into homogeneous acetates, this structure remains intact when the proportion of acetic acid is large; as this becomes smaller, the crystalline portion disappears, the amorphous phase being left. The variations of the structure of the haloes are studied with different proportions of acetic acid. The molecules of the colloidal gels, formed by the acetates of cellulose, appear to be arranged with a certain amount of regularity, in a manner analogous with that which is assumed for liquids. The medium is very viscous in the case of the colloids, which opposes the effects of molecular agitation. The method is useful industrially. H. N. A.

1810. Crystal Structure of Potassium Hydroxystannate, $K_2Sn(OH)_6$. R. W. G. Wyckoff. *Am. J. Sci.* 15. *pp.* 297–302, *April,* 1928.

The atomic arrangement is a distortion of the cubical K_2PtCl_6 structure by compression along a threefold axis. The positions of the K and Sn atoms can be expressed in terms of the one-molecule unit $a_0 = 5{\cdot}66_9$ Å., $\alpha = 70°\,1'$; Sn atom at 000, K atoms at $\underline{uuu}$, $\underline{\bar{u}\bar{u}\bar{u}}$, where $0{\cdot}25 < u < 0{\cdot}27$. This cell is developed from the space group ${}_3Di_{-5}$. The diffracting power of O is negligible compared with those of Sn and K, and it appears that these atoms have the same relative positions in a two-molecule structure arising from ${}_3D_{-6}$, as in the above one-molecule structure, so that it is not possible to decide between these two alternatives. H. N. A.

1811. Orientation and Structure of Crystal Fragments. W. E. Dawson. *Phil. Mag.* 5. *pp.* 756–768, *April,* 1928.

Describes a new form of X-ray spectrometer on the Weissenberg principle, in which the rotation of the crystal is accompanied by a proportional movement of the recording photographic plate or film. The incident pencil of X-rays is perpendicular both to the axis of rotation of the crystal and to the plane of the plate, which undergoes a tangential displacement relative to the rotating crystal holder. When the instrument is to be used to determine the orientation of a crystal fragment of known crystal structure, it is necessary to record only reflections of the monochromatic X-rays used from certain crystal planes. A lead screen with an annular hole is then used to cut off the unwanted reflections. The interpretation of the results is illustrated for the determination of the crystal orientation in an aluminium rod which consisted of two single crystals. W. H. GE.

1812. Linear Compressibility of Thirteen Natural Crystals. P. W. Bridgman. *Am. J. Sci.* 15. *pp.* 287–296, *April*, 1928.

The crystals measured were andradite, garnet, beryl, apatite, hanksite, tourmaline, quartz, rutile, barite, topaz, jeffersonite, orthoclase, spodumene. Particulars are given of the ways in which the specimens to be measured were cut, and a table shows the measured linear compressibility in different directions and the volume compressibility at 30° and 75° C. The values obtained are discussed and compared with those of other observers. It is shown that different samples of natural crystals, even in the case of quartz, may vary by measurable amounts. Topaz has a very large negative temperature coefficient of compressibility in the C direction; the temperature coefficient of the volume compressibility is also negative. Orthoclase has a negative coefficient of volume compressibility both in the first and second degree terms. H. N. A.

1813. Hexahydrated Double Sulphates Containing Thallium. A. E. H. Tutton. *Roy. Soc., Proc.* 118. *pp.* 367–392, *and* 393–426, *April* 2, 1928.

Gives precision measurements of the pure crystallographic data for the isomorphous series of monoclinic hexahydrated double sulphates and selenates containing thallium, so completing the description of a remarkable series of 77 isomorphous salts. The thallium salts have very high refractive indices, double refraction, and molecular refraction. W. H. GE.

1814. Behaviour of a Single Crystal of α-Iron Subjected to Alternating Torsional Stresses. H. Gough. *Roy. Soc., Proc.* 118. *pp.* 498–534, *April* 2, 1928.

Uses the Stromeyer alternating torsion machine in a somewhat improved form, and a new form of apparatus for measuring the slope and position of slip band markings. The range of torque had to be raised to ± 6 tons/inch^2 before slip band markings were produced after 1,410,000 reversals, which, however, were widely spaced and comparatively few in number; the range of torque was then adjusted to ± 8 tons/inch^2, at a frequency of 900 cycles per minute. The machine stopped after 118,000 reversals, and it was found that the specimen had cracked in fourteen different places; four well-defined zones existed in which no slip bands could be detected, at $\lambda = 5°$, 95°, 185° and 275° from the datum line on the cylindrical specimen. The slip bands in the remaining zones differed from one another at different parts of the specimen in slope, but regularities were found in proceeding round the cylinder, which are related to the orientation of the iron crystal determined by means of X-rays. As the result of a mathematical investigation of the direction of the slope at different parts, it appeared that the distortion did not take place as in aluminium, where the slip is confined to one type of plane (110, 112 or 123), but that there is in general duplex slip on two planes, not of the same crystallographic type, situated on opposite sides of the plane of actual maximum resolved shear stress, each plane being either a 110, 112 or 123 plane, and subjected to a greater resolved shear stress than any other plane of these three types situated on the same side of the actual maximum resolved shear stress. The direction of slip is the octahedral direction. The total deformation of the specimen during the test was measured, and found to be so small as to be negligible. The polished and etched cross-section of the specimen was also examined microscopically. H. N. A.

1815. X-Ray Study of Some Simple Derivatives of Ethane. Parts I and II. K. Yardley (Mrs. Lonsdale). *Roy. Soc., Proc.* 118. *pp.* 449–497, *April* 2, 1928.

Studies the following substances: C_2Cl_6, C_2Br_6, $C_2Cl_4Br_2$ (two forms), C_2Br_5F, $C_2Cl_3Br_3$, $C_2Br_4(CH_3)_2$ (two forms, one obtained below 0° C.). Various difficulties have been encountered, owing to the fact that some of the substances are very volatile, while C_2Br_6 and C_2Br_5F absorb the RbKα radiation very strongly. They all crystallise in the space-group Q_h^{16}, and the maximum and minimum values of the axial lengths are $a = 11{\cdot}51_3 - 12{\cdot}07_0$ Å., $b = 10{\cdot}14_5 - 10{\cdot}90_9$ Å., $c = 6{\cdot}39_4 - 6{\cdot}57_3$ Å. Four molecules exist per unit cell, each with a plane of symmetry parallel in the crystal to the (010) plane. This plane passes through the carbon atoms and two of the halogen atoms (in $C_2Br_4(CH_3)_2$ through the two CH_3 groups. C_2Cl_6, C_2Br_6 and $C_2Br_4(CH_3)_2$ molecules have a pseudo-centre of symmetry, which produces additional halvings. Both forms of $C_2Cl_4Br_2$ appear to have the formula $CCl_3 . CClBr_2$. It appears that the carbon atom has two A and two B valencies, which seem to be closely allied to the two (2, 1) and two (2, 2) electrons in the outer shell of neutral carbon. Composite F curves have been obtained for C_2Cl_6 and C_2Br_6, and are compared with Hartree's curves for ionised Cl^- and C^{++++}. In Part II $C_2Br_4(CH_3)_2$, tetragonal, has probably four molecules, in approximately face-centred positions, in a cell of size $8{\cdot}81^2 \times 11{\cdot}27$ Å.; the space group could not be determined. $C_2(CH_3)_4Br_2$, tetragonal needle-like crystals, has four molecules per unit cell of dimensions $10{\cdot}45^2 \times 8{\cdot}14$ Å.^{3}, in approximately face-centred positions with either a plane or dyad axis of symmetry or both. There are only two possible types of structure, which are illustrated. No X-ray data could be obtained for $C_2(CH_3)_6$ and $C_2(CH_3)_5$, which volatilise too quickly. $C(CH_3)_3 . C(CH_3)_2OH$ has an orthorhombic cell, $21{\cdot}35 \times 10{\cdot}77 \times 7{\cdot}84$ Å.^{3}, four molecules in approximately face-centred positions, space group C_{2v}^{21}. H. N. A.

1816. X-Ray Investigation of the Structure of Some Naphthalene Derivatives. J. M. Robertson. *Roy. Soc., Proc.* 118. *pp.* 709–727, *April* 2, 1928.

A detailed comparison of the structure of dichlornaphthalene tetrachloride (1.2.3.4.5.8.-hexachlornaphthalene-1.2.3.4.-tetrahydride) with that of naphthalene tetrachloride. The latter structure has already been determined by W. H. Bragg. The relative intensities of the spots in a series of oscillation photographs of the two crystals are estimated visually, aided by the approximately known ratio CuKα : CuKβ, and the results are interpreted on the lines of Bernal's paper [see Abstract 883 (1927)]. The general conclusions are: dichlornaphthalene tetrachloride closely similar in structure to naphthalene tetrachloride; lattice body-centred, most probable space group C_s^4, with four asymmetric molecules per unit cell; polar crystal. The two additional substituted chlorine atoms in dichlornaphthalene tetrachloride lie beneath the added chlorines (looking along the *c* axis). Hence the long axis of the molecule coincides approximately with the *c* axis of the crystal, the chlorines on either side of the molecule interleaving the carbon rings. Carbon rings almost flat. The original paper must be consulted for details of the photographs and their interpretation. H. R. R.

1817. Quaternary Zone Symbols. C. H. Edelman. *K. Akad. Amsterdam, Proc.* 30. 9–10. *pp.* 980–987, 1928.

Discusses the problem of finding quaternary symbols that are correspondent for corresponding zones and suggests the adoption of the Weber notation in preference to that of Viola. W. H. GE.

1818. Existence of Zero-Point Energy in the Rock-Salt Lattice by an X-Ray Diffraction Method. R. W. James, I. Waller and D. R. Hartree. *Roy. Soc., Proc.* 118. *pp.* 334–350, *March* 1, 1928.

The authors show that within certain limits of accuracy the F curve, or atomic scattering curve, of an atom for X-radiation can be calculated by applying the classical law of scattering to the Schrödinger distribution of charge. The result is used to compare the F curves calculated from the Schrödinger distributions for the ions Na^+ and Cl^-, obtained theoretically by an approximate method, with those obtained experimentally from observations on the rock-salt crystal at different temperatures. It is found that the F curves so calculated agree very closely with the experimental curves on the assumption that the crystal possesses zero-point energy of amount half a quantum per degree of freedom, as proposed by Planck. The difference between the F curves with and without this energy is considerable, since the amplitudes of vibration of the atoms at the absolute zero are somewhat greater than the radii of the regions within which the density distributions of K electrons are concentrated, and it is upon these electrons that the F curves at high angles of scattering mainly depend. A. B. W.

1819. Calculation of the Energy and Parameters of an Ionic Lattice of the Corundum Type. V. Schmaeling. *Zeits. f. Phys.* 47. 9–10. *pp.* 723–731, 1928.

Gives a short description of the corundum lattice. Assuming a coordination lattice formed of ions, which are regarded as rigid and spherical, the Coulomb potential is calculated as a function of two independent parameters. The lattice parameter for minimum energy is obtained with 5 % of deviation. A second idealised model is then assumed, with only one free parameter, which gives all the parameters better than the first. As a test the lattice energy of corundum is then calculated by means of Born's cyclical process. Using the value of the exponent n, which is determined from the compressibility, a value of the energy is obtained which is almost identical with that calculated from the lattice theory. H. N. A.

1820. Fundamental Frequencies, Interatomic Forces and Molecular Properties. J. R. Bates and D. H. Andrews. *Nat. Acad. Sci., Proc.* 14. *pp.* 124–130, *Feb.*, 1928.

The fundamental frequency of an atom vibrating harmonically in a crystal lattice is $\nu = 1/2\pi \,.\, \sqrt{K/M}$, where K is the force of unit displacement and M the mass of the atom. In the case of a diatomic molecule M is to be replaced by the reduced mass $\mu = 1/M_1 + 1/M_2$. If r is the distance between the two nuclei, K is proportional to the displacement $(r - r_0)$ from the point r_0, for which the potential is zero. If the vibration remained harmonic through all values of r, no dissociation could occur. The authors assume that the vibrations remain practically harmonic until a value r_D (dissociation) is reached, at which the restoring force suddenly becomes very small. According to the theory of the vibrational quantum, the vibration is indeed anharmonic in band spectra. For harmonic vibration $\nu = \nu_0 n$, where ν_0 is the fundamental frequency and n the quantum number; for anharmonic vibration $\nu = \nu_0 - bn^2$, where b is a constant for any series of levels. The distance $(r_D - r_0)$ represents, in the case of the harmonic oscillator, the distance to which the atoms must be pulled apart from equilibrium position to make the work done equal to the heat of dissociation. Further work has to be done at this point to prevent the atoms from flying apart. In the case of the anharmonic oscillator, the difference $(r_D - r_0)$ will be somewhat greater. In calculating the energy of dissociation the authors do not assume, as Eucken did, that K would be harmonic throughout. Their tables show a certain parallelity between fundamental frequency and heat of linkage (or heat of dissociation, as taken from other observers) for non-polar bonds (H–H, H–C, I–Cl, etc.) and polar bands (H–F, etc.); the frequencies vary over a large range only in the case of the latter bonds. There is, further, a curious relation between the K and the boiling point in the case of the halogens Cl_2, ICl, etc. A relation between frequency and directive influence in substitution (ortho, meta, para positions) is also pointed out. H. B.

1821. Energy of Dissociation of Diatomic Molecules. A. Carrelli. *N. Cimento*, 5. *pp.* 9–13, *Jan.*, 1928.

In this mathematical paper the author determines theoretically the sign of the corrective term that with closer approximation appears in the formula which gives the energy of dissociation of a diatomic molecule on the basis of a knowledge of its band spectrum. This means of finding the energy of dissociation from a study of the band spectrum was first enunciated by Franck. The author finds as a result of his analysis that the sign of the term sought for is always negative. The theory foresees for the terms of the third degree always a negative value. J. J. S.

1822. Molecular Structures of Methane. J. K. Morse. *Nat. Acad. Sci., Proc.* 14. *pp.* 166–171, *Feb.*, 1928.

Working with a carbon atom model described earlier [see Abstract 2208 (1927)], two-type structures to scale are presented for the methane molecule, one in which the hydrogen positions are joined to the carbon atom by a "single-electron" bond and the other in which this linkage is composed of two "electron positions." The calculated moments of inertia are compared with those derived from measurements by Cooley of the infra-red absorption spectra, and are found to be in quantitative agreement with the Cooley results. W. S. S.

1823. Production of Active Nitrogen. J. Kaplan. *Nat. Acad. Sci., Proc.* 14. *pp.* 258–260, *March*, 1928.

The author describes experiments in which active nitrogen has been obtained in air discharge tubes. Besides the α bands of N_2 and the β and γ bands of NO observed previously in the nitrogen afterglow, several new β and γ bands were identified. Second positive bands of N_2 and several members of the fourth positive group were also found, but the dispersion of the instrument used was not sufficiently great to separate many bands. The presence of either of these positive groups in the afterglow indicates more than the energy of recombination of nitrogen atoms, and raises a difficulty for the hypothesis that active nitrogen is atomic. Further, no bands are present from transitions to the normal level of the molecule with intensities comparable to the β or γ bands, since no members of the Lyman-Birge-Hopfield bands or the predicted A–X bands were found.

Photographs taken to find the difference between the active N_2 producing discharge and the discharge producing the yellow-green afterglow confirm Strutt's results with nearly pure N_2. Since the second and fourth positive groups of the band spectrum of the N_2 molecule are emitted when the molecule changes from the C and D levels to the B level, these results indicate that both the C and D levels for the N_2 molecule are very unstable, while the presence of these positive bands indicates that active N_2 is atomic. Since the dissociation by collision from the D level exceeds that from the C level, this may account for the weaker development of the fourth compared with the second positive level. R. S. R.

1824. Thirty-Fourth Annual Report of the Committee on Atomic Weights. G. P. Baxter. *Am. Chem. Soc., J.* 50. *pp.* 603–617, *March,* 1928.

The report of the Committee reviews the determinations published during 1927. They concern boron, carbon, nitrogen, chlorine, scandium, potassium, argon, silver, antimony, dysprosium and the isotopes of tin, xenon, mercury and lead. The table added to the report suggests slight changes in the atomic weights of helium (now 4·002), argon (39·94), neon (20·183), dysprosium (162·46), yttrium (88·92), but on the author's own behalf, not on behalf of the Committee. H. B.

1825. Electric Moment of Alkali Atoms. J. J. Weigle. *Phys. Rev.* 31. *pp.* 672–675, *April,* 1928.

The electric moments of atoms can be calculated if we know the constant a of van der Waals. This constant can be obtained from the vapour pressure equation. Thus for all the substances for which the vapour pressure curve has been determined it is possible to calculate the electric moment or the electric moment of inertia. These computations have been made for the alkali atoms giving $0\cdot 18\times 10^{-18}$, $0\cdot 24\times 10^{-18}$, $0\cdot 24\times 10^{-18}$, $\text{gm.}^{1/2}\ \text{cm.}^{3/2}\ \text{sec.}^{-1}\epsilon$ as the electric moments of Na, K, Rb respectively. These values, although not very accurate, are interesting, for Bohr's picture of the alkali atom, with the penetrating orbit of the valence electron precessing around the nucleus, gives no electric moment. The values above are so small as to be negligible and thus in accord with the theory.

AUTHOR.

1826. Group Theory of Homopolar Chemical Combination. W. Heitler. *Zeits. f. Phys.* 47. 11–12. *pp.* 835–858, 1928.

Refers to a paper by Heitler and London, where the conditions in which two hydrogen atoms will combine or repel one another when they come together are worked out [see Abstract 3046 (1927)]. Working along the same lines, the author uses the group theory to calculate the perturbation energy between two atoms A and B, each of which has n photoelectrons. If both atoms are in the state of highest multiplicity ($n + 1$ fold), there will always be, amongst their different energies of mutual action, at least one, and sometimes several, which imply attraction between A and B, and the formation of a molecule. The most important homopolar molecules of chemistry are formed in this way. N_2 is taken as an example. There are three photoelectrons in the L_2 layer and the L_1 layer is "closed." The theory indicates four different energies of mutual action for the quartet term system, which constitutes the fundamental system of the atom, and curves are drawn, qualitatively, showing how these energies vary with the distance. Two of these pass below the zero line, and have a minimum value which corresponds to equilibrium of the atoms in a molecule. The energy of dissociation of one of these must be about three times as great as that of the other. Sponer has found a metastable electronic term for the N_2 molecule, which may correspond to the second of these. The other two states have always positive energies, so that atoms in either of them will always give elastic reflection. Atoms in two different states will not combine. In a very recent paper London has arrived at very similar results by another method. [See Abstract 842 (1928).] H. N. A.

1827. Recent Progress in Theoretical Physics. H. F. Biggs. *Nature*, 121. *pp.* 503–506, *March* 31, 1928.

A lucid account is given of the new statistical principle, known as the Fermi-Dirac statistics, which is an extension of Pauli's prohibition, by which no two electrons in an atom can have exactly the same set of quantum numbers. The applications of the new principle are briefly indicated; in particular a sketch is given of Sommerfeld's reconstruction of the Drude theory of electronic conduction, which accounts successfully for the old difficulty of the negligible contribution of the electrons to the specific heat. The article concludes with a comparison of the classical, Bose-Einstein, and Fermi-Dirac statistical principles. W. S. S.

1828. New Quantum Mechanics. W. F. G. Swann. *Frank. Inst., J.* 205. *pp.* 323–382, *March*, 1928. *Paper read before Am. Assoc. for Advancement of Science, Philadelphia, December*, 1926.

This address is an exposition in semi-popular form of the matrix mechanics of Born, Heisenberg, and Jordan and of the wave mechanics of Schrödinger. These theories are presented, stripped of all unessential argument, the fundamentals being in each case explained in considerable detail. The treatment is also critical, and the difficulties of interpretation in physical terms of the mathematical processes involved are dwelt upon. In particular the inadequacy of the Schrödinger theory to account for emission in quanta is cited as throwing the physicist back to the device of matrix theory, namely transition probabilities, in place of the continuous radiation which presented one of the most attractive features of the Schrödinger conception. A possible way of minimising the difficulty is discussed in another paper. [See next Abstract.] W. S. S.

1829. Concepts in Quantum Theory. W. F. G. Swann. *Frank. Inst., J.* 205. *pp.* 519–538, *April*, 1928.

After a preliminary discussion on the lines of that of a previous paper [see preceding Abstract] the suggestion is put forward that in place of the Schrödinger charge density, given in the general case by $[\psi_1^2 + \psi_2^2 + \ldots + \psi_1\psi_2 \cos\frac{2\pi}{h}(E_1 - E_2)t + \ldots]$, where ψ_n and E_n are the nth eigen function and eigen energy respectively, another definition be adopted which implies that only when the atom is in process of radiating does a Schrödinger charge density exist, and that then it is given by $\psi_m\psi_n \cos\frac{2\pi}{h}(E_m - E_n)t$. The atom is assumed to be capable of emitting only one type of radiation at a time, in this case that corresponding to the transition $m \rightarrow n$. This notion is developed briefly. W. S. S.

1830. Calculation of Disturbance in Wave Mechanics. B. N. Finkelstein and G. E. Horowitz. *Zeits. f. Phys.* 48. 1–2. *pp.* 92–94, 1928.

This mathematical paper investigates the relationship between the Schrödinger and the Dirac calculation of disturbance in wave mechanics.

H. H. Ho.

1831. Statistical Theory of the Transition between Two Excited States of an Atom. K. Bollert. *Zeits. f. Phys.* 48. 1–2. *pp.* 98–110, 1928.

The author deals first with special types of probability conditions and processes which possess a close relation to complex numbers. An attempt is then made to relate these probable states with the excited states of an atom and the transition between them. It also yields an obvious explanation of the equations $E_1 - E_2 = h\nu$ and $\nu_{ik} = \nu_{im} + \nu_{mk}$. A result of this theory is a certain scope for the possibility of a special transition leading to a scattering effect. From this scattering effect, which shows itself spectroscopically in the natural width of the lines, and from the time of decay, the wave energy and wave number of the light quanta can be calculated. In conclusion it is shown that with consideration of the lack of sharpness in the transition the Bohr frequency conditions and the Heisenberg quantum conditions remain strongly confirmed. R. S. R.

1832. Principle of Interpretation in Matrix Mechanics, and the Spectral Theory of Bohr's Nearly Periodic Functions. A. Wintner. *Zeits. f. Phys.* 48. 3–4. *pp.* 149–161, 1928.

The question of the essential possibility of the principle by means of which one passes from the classical function to a matrix in Heisenberg's kinematics is raised, and answered by a generalisation of the theory of Laurent matrices, and by reference to Bohr's investigations, the result being that the collection of values (" Wertevorrat ") and the spectrum of the Hermite form assigned to an oscillation coincide exactly, and also in weight, with the system of values of the classical oscillation. Certain results follow directly with regard to the invariant character of the frequency of the form of motion with equivalent amplitude. These results are postulated in connection with the most recent views as to the nature of vibrational processes. H. N. A.

1833. Dirac's δ-Function in the Theory of Linear Integral Equations. M. J. O. Strutt. *Zeits. f. Phys.* 48. 3–4. *pp.* 162–164, 1928.

Shows that the δ-function employed by Dirac in the solution of atomic problems has properties which make its use advantageous in the theory of linear integral equations. H. N. A.

1834. Correspondence Principle in Statistical Interpretation of Quantum Mechanics. J. H. van Vleck. *Nat. Acad. Sci., Proc.* 14. *pp.* 178–188, *Feb.*, 1928.

Traces the asymptotic connection between the formulæ of the transformation theory of Dirac and Jordan and those of the classical theory. In doing this it is shown that (q/a), the probability amplitude or transformation function associated with the passage from the p, q to the α, β system of variables of Dirac and Jordan, when calculated to the second approximation, always contains the factor $\Delta^{\frac{1}{2}}$, where Δ is the functional determinant $\Delta = \frac{\partial(\beta_1, \ldots, \beta_s)}{\partial(q_1, \ldots, q_s)} = \left|\frac{\partial^2 S}{\partial_{q_k} \partial a_j}\right|$. H. N. A.

1835. Generalised Spheroidal Wave Equation. A. H. Wilson. *Roy. Soc., Proc.* 118. *pp.* 617–635, *April* 2, 1928.

The author investigates the generalised spheroidal wave equation

$$d/d\xi\{(1-\xi^2)dX/d\xi\} + \{\lambda^2\xi^2 - 2p\lambda\xi - n_3^2/(1-\xi^2) + \mu\} X = 0,$$

which occurs in the problem of determining the possible energies of the ion of molecular hydrogen by means of Schrödinger's wave theory. §§ 1–5 deal with the cases which arise when $p \neq 0$, and §§ 6–10 when $p = 0$. In the physical problem solutions are required which are bounded in the real interval $1 < \xi < \infty$. Solutions are given both in a finite form and in descending powers of the variable, their relationships being discussed at length. Asymptotic expansions are also derived for large values of λ.

H. H. Ho.

1836. Energy of the He Atom and of the Positive H_2 Ion in the Normal State. B. N. Finkelstein and J. E. Horowitz. *Zeits. f. Phys.* 48. 1–2. *pp.* 118–122, 1928.

Compares the methods of recent papers by Wang, who has used the Ritz method to obtain the energy of the fundamental state of the hydrogen molecule [see Abstract 827 (1928)], by Heitler and London, who have attacked the same problem [see Abstract 3046 (1927)] and by Sugiura [see Abstract 825 (1928)]; criticises the results of Heitler and London and of Sugiura, and shows that Wang's solution satisfies the quite evident and natural requirement that, when R (the distance between the nuclei) is made zero, the result is the energy of the normal helium atom. Derives an expression for the energy of the positive H_2 ion in the normal state. **Errata,** *ibid.* 48. 5–6. p. 448, 1928. H. N. A.

1837. Ionised Hydrogen Molecule. A. H. Wilson. *Roy. Soc., Proc.* 118. *pp.* 635–647, *April* 2, 1928.

When the protons are considered at rest, the system for the ion of the hydrogen molecule becomes a particular case of the problem of three bodies which has been solved by Pauli, who obtained a value for the energy of the normal state not in agreement with the experimental result inferred from the ionisation potential and heat of dissociation of the molecule, and later by Niessen [see Abstract 2902 (1927)], who obtains the experimental result by the introduction of half-integer quantum numbers. The classical problem is separable in elliptic coordinates, and the application of Schrödinger's method to the system results in a wave equation separable in the same coordinates. These differential equations are now obtained, their relevant properties stated, their relationships discussed, and values for the energies of the various states derived. Several surprising results appear. In the first place no solution is in general possible, and solutions will only occur for certain distances apart of the nuclei. In the second place it seems probable that these states are illusory and that there are no positive distances of the nuclei which give states. The various difficulties raised are fully examined in the paper. H. H. Ho.

1838. Zeeman Effect and Stark Effect of Hydrogen in Wave Mechanics; the Force Equation and the Virial Theorem in Wave Mechanics. A. E. Ruark. *Phys. Rev.* 31. *pp.* 533–538, *April,* 1928.

The Zeeman levels of hydrogenic atoms are determined by a new and simple method, neglecting terms in H^2. The frequency of the Larmor precession is $L = L_0(1 + E/mc^2)$. L_0 is the frequency of precession obtained by Newtonian mechanics and E the energy of the atom. This agrees with a formula of Pauli obtained by ordinary relativity mechanics. The formulæ for the first-order Stark effect and for the Paschen-Back effect can be obtained by similar methods. An extension of Ehrenfest's law of motion for a particle is proved. It is applicable to any conservative system. From it a theorem of wave mechanics analogous to the virial theorem is obtained. AUTHOR.

1839. Problem of the Normal Hydrogen Molecule in the New Quantum Mechanics. S. C. Wang. *Phys. Rev.* 31. *pp.* 579–586, *April,* 1928.

The solution of Schrödinger's equation for the normal hydrogen molecule is approximated by the function $C[e^{-z(r_1+p_2)/a} + e^{-z(r_2+p)/a}]$, where $a = h^2/4\pi^2me^2$, r_1 and p_1 are the distances of one of the electrons to the two nuclei, and r_2 and p_2 those for the other electron. The value of Z is so determined as to give a minimum value to the variational integral which generates Schrödinger's wave equation. This minimum value of the integral gives the approximate energy E. For every nuclear separation D, there is a Z which gives the best approximation and a corresponding E. We thus obtain an approximate energy curve as a function of the separation. The minimum of this curve gives the following data for the configuration corresponding to the normal hydrogen molecule: the heat of dissociation = 3·76 volts, the moment of inertia $J_0 = 4{\cdot}59 \times 10^{-41}$ gm. cm.^{2}, the nuclear vibrational frequency $\nu_0 = 4900$ cm.$^{-1}$. AUTHOR.

1840. Correspondence Relationship between the Matrix and Fourier Coefficients of Hydrogen Problems. C. Eckart. *Zeits. f. Phys.* 48. 5–6. *pp.* 295–301, 1928.

Debye [see Abstract 1653 (1927)] and the author [see Abstract 1283 (1927)] have each attempted to give a general proof that the matrix elements for infinitely large quantum numbers and vanishing h pass into the Fourier coefficients of classical motion. In the present paper the general element of the matrix of the radius vector in the hydrogen problem is expressed by means of Epstein's formula as a hypergeometric function. The limiting value of this function for $h = 0$ and quantum number ∞ is then calculated, and is found in agreement with the Fourier coefficients of classical motion. The result obtained is in accord with Bohr's correspondence principle. H. H. Ho.

1841. Energy Levels of the Hydrogen Atom According to Dirac's Quantum Theory of the Electron. W. Gordon. *Zeits. f. Phys.* 48. 1–2. *pp.* 11–14, 1928.

The Dirac theory [see Abstracts 1168 and 1507 (1928)] is applied to the determination of the levels in the hydrogen atom. It is established that the theory leads precisely to the Sommerfeld fine-structure formula. W. S. S.

1842. Gleich's Hypothesis of a Moving Electron with Constant Mass and Variable Charge. W. Anderson. *Ann. d. Physik*, 85. 4. *pp.* 494–496, *Feb.* 21, 1928.

According to Gleich's recent hypothesis, the mass of a moving electron remains constant, whilst the electrodynamic effect of the charge varies according to the law $e = e_0\sqrt{1 - \beta^2}$. This assumption has the same consequences in the atomic model as that in which the charge is constant and the mass variable [see Abstract 2590 (1927)]. If the calculation is made with the following assumptions: constant electronic mass, collision of one proton with one electron, speed of both very small before the collision, conversion of the proton alone into an energy quantum of wavelength λ, impulsion of the electron in the opposite direction, then λ is $4 \cdot 1 \times 10^{-12}$ cm. Millikan has found, for cosmic radiation, waves of minimum length $3 \cdot 8 \times 10^{-12}$ cm. His observation supports Gleich's theory, and is in disagreement with the alternative theory of changeable mass. [See also Abstract 1313 (1927).] G. E. A.

1843. Wave Mechanics of the Rotating Electron. J. Frenkel. *Zeits. f. Phys.* 47. 11–12. *pp.* 786–803, 1928.

This paper continues a previous investigation [see Abstract 2371 (1926)] on the corpuscular mechanics of the rotating electron, and attempts to set up the corresponding wave-mechanics equations in a relativity invariant form. This is brought about by adding to the ordinary Schrödinger scalar ψ a skew symmetrical tensor $\psi_{\alpha\beta}$, which replaces the magneto-electric moment of the electron and enables the determination of the components connected with ψ from a system of seven similar equations, whereby the volume density of the magneto-electric moments are derived by means of the products $m_0\psi_{\alpha\beta}\psi$. The equations obtained are very analogous to those derived by Darwin, but have the advantage of being invariant. It is also sought to derive the tension $\psi_{\alpha\beta}$ by a system of equations which give the immediate generalisation of the Maxwellian equations for the field tensor $F_{\alpha\beta}$, and pass into the latter when in the limit charge and mass vanish together. The moment of the electron appears, therefore, automatically (and not as a new constant) in the differential equation for ψ_α. Finally, it is shown that these differential equations are practically equivalent to the original equations. H. H. Ho.

1844. Wave Equations of the Electron. C. G. Darwin. *Roy. Soc., Proc.* 118. *pp.* 654–680, *April* 2, 1928.

Dirac's new quantum theory of the electron [see Abstracts 1168 and 1507 (1928)] is redeveloped, using in place of the method of q-numbers the ordinary methods of wave calculus. It is shown how Schrödinger's equation and the pair of equations given recently by the author are successive approximations to Dirac's system of four equations. Motion in a central field is dealt with, and the energy levels of the hydrogen atom are found to be exactly those given by Sommfereld's original formula. An outline of the combination rules and a discussion of the Zeeman effect are included. W. S. S.

1845. Scattering of Slow Electrons. J. Holtsmark. *Zeits. f. Phys.*, 48. 3–4. *pp.* 231–243, 1928.

Faxén and the author in a previous paper [see Abstract 37 (1928)] have shown how the scattering of a beam of electrons by atoms can be calculated, with good quantitative approximation, by means of the Schrödinger undulatory mechanics when the atomic field is known. The case of centrally symmetrical atoms was worked out, and in the present paper the behaviour of argon is studied in detail, an estimate of the density of electrons at different distances from the centre of the atom being made and the field intensities and potentials calculated. A curve for the area of the active section of the atom at small velocities of the electrons is obtained which is very similar to the experimental curves; the theoretical curve, like the experimental, shows a minimum of scattering for a certain electronic velocity, but to get the exact position of this minimum a better knowledge of the atomic field is necessary. A similar calculation in the case of neon does not result in such good agreement with the results of observation, but the appearance of the minimum is general in the centrally symmetrical atoms, which agrees with the latest experimental results of Brüche. This Ramsauer effect must also occur more or less distinctly in the case of atoms which are not centrally symmetrical. The theory also agrees with Brüche's experiments in stating that the law of additivity does not hold for compound molecules, but that the absorption of molecules of similar structure, like CO and N_2, is quite similar. The paper concludes with some remarks on the existence of large electronic orbits, for which the original should be consulted. H. N. A.

1846. Quantum Theory of the Ramsauer Effect. J. R. Oppenheimer. *Nat. Acad. Sci., Proc.* 14. *pp.* 261–262, *March,* 1928.

A theory, taking into account electronic resonance and spin, is sketched which is adequate to account for the effects observed by Ramsauer.

J. S. G. T.

1847. Theory of the Magnetic Electron. Part I. D. Iwanenko and L. Landau. *Zeits. f. Phys.* 48. 5–6. *pp.* 340–348, 1928.

By the introduction in place of the ordinary Schrödinger wave function ψ of a series of antisymmetrical tensors of different rank ψ_{ikl} . . ., it is found possible to lay down relativistic invariant equations which, without any assumption as to rotation, lead to the observed effects corresponding to the magnetic electron. The standpoint adopted is similar to that of Dirac [see Abstracts 1168 and 1507 (1928)], and the results of the theories for the single electron case are identical. The present method can be generalised for the several electron problem which would appear to present difficulties on Dirac's theory. W. S. S.

1848. Quantising a Harmonic Oscillator in a Magnetic Field. V. Fock. *Zeits. f. Phys.* 47. 5–6. *pp.* 446–448, 1928.

The determination of the exact values of the energy levels of an isotropic plane harmonic oscillator in a magnetic field at right angles to the plane is the simplest example of the application of the perturbation method to a degraded mechanical system. The author expresses the energy in terms of the proper frequency ν_0 of the oscillator and of the Larmor frequency $\nu_1 = eH/4\pi mc$. Modifying the Hamilton function of H, he arrives at an expression which corresponds to Schrödinger's amplitude equation and which can be solved by separating the variables. The equation thus deduced is the same as if the oscillator were not in an isotropic magnetic field, the case already studied by Schrödinger [see Abstract 2537 (1926)].

H. B.

1849. Conservation Laws in World Geometry. E. Reichenbächer. *Zeits. f. Phys.* 48. 5–6. *pp.* 440–445, 1928.

A brief derivation is given of the identical relations holding between the field equations, by a method employing a finite coordinate transformation in place of the infinitesimal transformation of the previously published proofs. W. S. S.

METEOROLOGY AND GEOPHYSICS.

1850. Observations and Investigations at the Blue Hill Meteorological Observatory in 1927. A. McAdie. *Blue Hill Meteorolog. Obs., Cambridge, Mass.* [36 *pp.*], 1928.

Tabular information provides (1) a summary of meteorological elements for 1927, (2) advance of the seasons each year 1886–1927, (3) constants and 42-year values, (4) monthly rainfall and temperature for 1886–1927, snowfall each month 1885–1928, and days of snow-covered ground 1894–1928. The author next gives an historical survey of the various cloud classifications proposed from the time of Luke Howard to the present day. He finally suggests a classification based upon appearance, origin and motion, the last being the most important. Horizontal and vertical motion and cross-currents provide the basis for classification, and the symbols are respectively H, V and CC. Altitude will be introduced by *l* for lower, *m* for medium, and *h* for high bases, while direction and speed will be given in degrees and metres per second, *e.g.*, Hl 270° 9 m./s. A series of twenty-one plates illustrates the different cloud types. R. S. R.

1851. Periodograms and Harmonic Analysis. D. Brunt. *Roy. Meteorolog. Soc., Mem.* 2. 15. *pp.* 47–68, *March*, 1928.

A summary of formulæ used in harmonic analysis is given, and a calculation of the standard deviation of a series of observations for the effect of an harmonic variation. Schuster's formula for the amplitudes of the Fourier coefficients for a random series of observations is derived, and Walker's method of determining the "probable greatest amplitude" in periodogram interpretation is criticised. The London temperature periodogram is used to illustrate the points raised. A. Wh.

1852. Wright Radiation at Lausanne. P. L. Mercanton. *Comptes Rendus*, 186. *pp.* 965–967, *April* 2, 1928.

Observations of temperatures, humidity and nocturnal radiation were made on 120 nights when either cloudless or overcast skies existed. The energy radiated was expressed (1) in cal./cm.^{2}, min., and (2) as a fraction of that emitted by a black body, at the temperature of the surrounding air, but in an enclosure at the absolute zero. This latter method shows better the protecting influence of the atmosphere. Under varying temperatures and relative humidities, but mainly in light winds, it was found that for (1) clear nights the radiation amounted to between 0·070 and 0·157 cal./cm.^{2}, min., and a fraction of black-body radiation between 15·2 % and 30·8 % (mean 20·9 ± 0·2 %); there was no marked correlation with vapour pressure; (2) overcast nights, when clouds rested even several hundred metres thick above the observation post, the mean radiation was 0·0035 cal./cm.^{2}, min., and on occasions even zero while the fraction was 0·8 %. The observations are to be brought into relation with the meteorological conditions. R. S. R.

1853. Petersen's Hypothesis that the Highest Atmospheric Layers are Heated by β-Radiation. W. Anderson. *Phys. Zeits.* 29. *pp.* 232–233, *April* 15, 1928.

The author criticises the conclusions drawn by Petersen (see Abstract 2835 (1927)]. (1) If only β-radiation were emitted by the sun, then for the fastest radiation the sun would acquire in 0·8 sec. a voltage sufficient to stop it. (2) Benndorf states that a positive stream of equal speed and intensity must also be emitted, and on account of the relative mass of the proton this stream will possess much more energy and possess the greater rôle in heating the air. Thus the hypothesis is true only if a partial destruction of protons takes place in the sun. (3) The electrons reaching the earth would in 3 sec. raise a sphere of radius 10^6 km. to $2 \cdot 7 \times 10^7$ volts, and so stop even the fastest electrons. Thus if Petersen's hypothesis is true, the ordinary electrostatic laws fail, an assumption the author was also compelled to make with his corona investigations.
R. S. R.

1854. Ocean Surveys: Problems and Developments. J. P. Ault. *Washington Acad. Sci., J.* 18. *pp.* 109–123, *March* 4, 1928.

The paper provides first a general review of the problems investigated and observations made during former ocean cruises to determine the relations between variations of magnetic conditions, atmospheric electricity, auroral displays, earth currents, and the transmission of wireless waves, variations of temperature, density and salinity of sea, nature of ocean beds and marine life. The subjects to be investigated during the *Carnegie* cruise, 1928–31, include (1) the temperature, density, salinity and chemical composition of the sea-water at various depths; (2) samples of the muds and sediments from the ocean bed; (3) depth soundings by wire and echo; (4) microbiology; (5) meteorology, temperature and humidity, lapse rates from sea-level to masthead, solar radiation, clouds, rainfall evaporation, and CO_2 and dust content of the air. Pertinent oceanographic data will be published during the cruise. See also *Programme of Scientific Work on Cruise VII of the Carnegie*, 1928–1931. **J. A. Fleming** and **J. P. Ault.** (*Terr. Mag.* 33. pp. 1–10, March, 1928).
R. S. R.

1855. Earth Stratification. R. A. Daly. *Am. J. Sci.* 15. *pp.* 108–135, *Feb.*, 1928.

The calculations of physicists lead to conclusions about the constitution of the outer earth not in accordance with geological data. In particular figures indicating the improbability of a basaltic layer below the outer granitic are not supported by geological evidence. The physical constants for surfaces and sub-surface rocks rest upon a body of assumptions. The data also vary; for example, elasticities on the same material calculated from high stresses differ considerably from those obtained by the velocity of sound in the material, *i.e.*, at low stresses. A stratification differing from that obtained on geological grounds does not follow essentially from the physical data available.
W. A. R.

1856. Thermal Instability of the Earth's Crust. H. H. and J. H. J. Poole. *Phil. Mag.* 5. *pp.* 662–667, *March*, 1928.

Referring to Jeffreys' criticism [see Abstract 1196 (1928)] of Joly's paper on the earth's thermal history, the authors of this paper point out that Jeffreys' main contention is that if the substratum contains more radioactive elements than are sufficient to supply the present loss of heat from the earth's surface, the future state of the earth will be one in which a layer of molten rock of fixed thickness and temperature-gradient will be overlain by a solid crust, also of a fixed thickness. Loss of heat by conduction will exactly counterbalance generation of radioactive heat, and a steady state will be attained. It follows from this that the substratum cannot contain more radioactive materials than are sufficient to account for the present rate of loss of heat. This view is opposed by all the actual measurements of the uranium and thorium contents which probably constitute the substratum. However, besides this, Jeffreys' contention is based on the assumption that it would be possible for a layer of molten magma to persist indefinitely beneath a roof of solidified magma of the same composition. The authors point out that thermodynamical principles contradict this unless high subterranean pressures introduce unexpected effects. The necessary conclusion the authors consider must be that a deep layer of magma with radioactivity comparable with that of surface rocks would undergo periodic changes of state accompanied by corresponding changes in the temperature gradient of the overlying crust. There are two alternatives: (*a*) The radioactivity of the deep-seated rocks is not comparable with available specimens. Then the revolutions for which geologists have found evidence must be assumed as not occurring or unexplained. (*b*) It may be assumed that radioactive measurements of available specimens are of value. Then an explanation of these revolutions is forced upon us. J. J. S.

1857. Geophysical Prospecting. A. S. Eve. *Nature*, 121. *pp.* 359–362, *March* 10, 1928.

The author briefly reviews methods used to locate ores and oil. For the ores he deals with: (1) Electrochemical detection as used by Barus and extended by Schlumberger; (2) electrical, where equipotential lines are traced but which is difficult with ores whose conductivity is much the same as that of the surrounding rock; (3) magnetic methods; and (4) electromagnetic methods with direction-finding coils in which the electrical echo is sought. For oil-hunting he instances: (1) Seismic methods in which an artificial explosion is caused and detected in a seismograph a few miles away; (2) gravitational methods, an Eötvös torsion balance being employed; (3) magnetic when disseminated magnetite occurs; and (4) electrical methods, but on a larger scale than for ore exploration. He concludes that these methods wisely used can be helpful and profitable, but improper claims regarding them should not be made. R. S. R.

ASTROPHYSICS.

1858. Unsöld's Theory of the Chromosphere. E. A. Milne. *Zeits. f. Phys.* 47. 9–10. *pp.* 745–750, 1928.

Refers to Unsöld's paper [see Abstract 286 (1928)]. The theory differs completely from that which has been developed by the author, who in the present paper shows that Unsöld's chromospheric pressure is quite impossible, and should be lower by an order of magnitude. A short account is given of the mechanism by which the chromosphere is developed, and held in an equilibrium which is not thermodynamic, above the reversing layer, in which the equilibrium is thermodynamic. Develops his arguments against Unsöld's theory, referring to his recent paper in the *Monthly Notices*, in which the same arguments are used. H. N. A.

1859. Unsöld's Theory of the Chromosphere. W. Anderson. *Zeits. f. Phys.* 48. 5–6. *pp.* 447–448, 1928.

Considers Unsöld's reply to the author's previous paper [see Abstract 863 (1928)], and shows that Unsöld is not correct in thinking that the author considers that the "residual intensity" in the middle of the line is due to radiation from the photosphere which has not been scattered. The opinion that the selective radiation pressure is much too small to maintain Unsöld's chromosphere in equilibrium is upheld. The theory is also attacked from a new standpoint. If the partial pressure of the free electrons in the chromosphere amounted to 10^{-6} atm., as Unsöld assumes, it would give a continuous spectrum, in addition to its line spectrum, the intensity of which would be too large to escape observation. In a footnote attention is called to Milne's estimate of 10^{-13} atm. for the partial pressure of the electron gas in the chromosphere and to the fact that in the author's previous paper, cited above, he has mentioned that such a low pressure is inconsistent with Woltjer's calculations. H. N. A.

1860. Systematic Deviations from the Mean Stellar Distribution. F. H. Seares and Mary C. Joyner. *Mt. Wilson Observat., Contrib. No.* 346. *Astrophys. J.* 67. *pp.* 24–82, *Jan.*, 1928.

Values of O − C in log N_m for $m = 9{\cdot}0,\ 11{\cdot}0,\ 13{\cdot}5,\ 16{\cdot}0$, and $18{\cdot}0$ have been calculated for 10° intervals in galactic longitude in latitudes 0°, 5°, 10°, 20° . . . 70°, north and south. The deviations thus found refer to the mean distribution in Table XVII, Contribution No. 301. The data are from the Mt. Wilson Catalogue of the Selected Areas, from numerous zones of the Astrographic Catalogue, and from the Harvard-Groningen Durchmusterung. The counts from the Durchmusterung were used only for $\delta = -30°$ to $-90°$. They refer to limiting magnitude 16·86, assumed to be constant for all the fields. This assumption, unavoidable at present, introduces considerable uncertainty; but a similar treatment of the counts for $\delta = -15°$ to $+90°$ shows that the fluctuations in the limiting magnitude are not large enough to mask the characteristic features of the distribution. The principal irregularity is of the form

$$\Delta = a + b \cos (\lambda - L').$$

The values of the parameters for different zones of latitude are such as would be expected from a displacement of the sun from the centre of an approximately symmetrical stellar system. The asymmetry in latitude $\frac{1}{2}(a_N - a_S)$ depends on the limiting magnitude; for $m = 15$ and fainter it is negligible, whence it follows that the solar system is almost exactly in the galactic plane defined by the faint stars. The longitude of the centre of the stellar system, L′, also depends on the limiting magnitude. Systematic differences in b and L′ for northern and southern latitudes indicate the necessity of a correction to the adopted position of the galactic pole (Gould). The discussion is continued in Contribution No. 347 [see next Abstract]. AUTHORS.

1861. Structure of the Galaxy. F. H. Seares. *Mt. Wilson Observat., Contrib. No.* 347. *Astrophys. J.* 67. *pp.* 123–178, *March*, 1928.

The observed systematic deviation from mean stellar distribution has been represented by $\Delta = a + b \cos (\lambda - L')$ [see preceding Abstract]. The theoretical deviations for an eccentric location of the sun within a stellar system having spheroidal symmetry have the form $\Delta = S \pm G + F \cos (\lambda - L) \pm K \cos (\lambda - L_0)$. The hypothesis underlying the theoretical formula holds for any given limiting magnitude, but the spheroid representing the system varies. Higher harmonics are involved in the residuals given by the theoretical formula. The bright helium stars are but the nucleus of a much larger local system, having a diameter of about 6000 parsecs. The distance of the sun from the galactic planes of the systems of brighter stars is about 0. The distance from the plane of the local cluster is in excess of 30 parsecs, probably 40–50 parsecs. Schwarzschild's method is used to calculate the directions of centre, anti-centre and poles. The distribution in the directions of centre and anti-centre is very asymmetrical, and the distribution curve of density in the direction of the centre may be resolved into a symmetrical curve representing the local cluster concentric with the sun and an asymmetrical curve representing the larger system. The final hypothesis regards the Galaxy as an organisation from 60,000 to 90,000 parsecs in diameter resembling the highly resolved spiral nebulæ. The local cluster contains many million stars, and may correspond with one of the condensations in the arms of a spiral, although it is apparently of rather exceptional relative size. A. Wh.

1862. Effective Wave-Length of Stars. M. Maggini. *Accad. Lincei, Atti,* 7. *pp.* 56–61, *Jan.* 8, 1928.

The measurement of astral diameters and distances by the interferometer depends on the λ chosen as the effective λ. This depends on the star itself (particularly on the distribution of energy in its spectrum), on the achromatic correction of the refractor, and on the sensitiveness of the observer's eye, and on the selective absorption of our atmosphere. The best criterion for interferometric effective λ is that monochromatic λ which, on being substituted for the star-light, gives the same appearance to the fringes. Gives a method of ascertaining this. The four satellites of Jupiter are found to reflect solar light in different manners. Data are given for twenty double stars. A. D.

1863. Absorption of Star-Light. G. Andrissi. *Accad. Lincei, Atti,* 7. *pp.* 61–65, *Jan.* 8, 1928.

Measurements of absorption in the atmosphere of Rome. A. D.

1864. Time of Relaxation of Closed Stellar Systems. S. Rosseland. *Roy. Astron. Soc., M.N.* 88. *pp.* 208–212, *Jan.,* 1928.

If Q be the kinetic energy gained by a star in motion through a stellar system in dynamical equilibrium, the author finds that $E = \sum_i Q_i$, where E is the arithmetic mean increase in kinetic energy of the star in the given time-interval, and due to encounters; and $L^2 = \sum_i Q_i^2$ where L^2 is the quadratic mean increase of kinetic energy in encounters in the same interval of time. E will rarely exceed the average kinetic energy of a star in the system, but L^2 will increase indefinitely and proportionately with the time, since each encounter gives a positive contribution; therefore the deviation grows, until the star can no longer be identified by its mean orbit. The time of relaxation (τ) is either that necessary for L to become of the same order as the initial energy of the star (this being in excess of the average), or that which makes L equal to the average kinetic energy of a star of the system. He finds

$$\tau^{-1} = 16\pi G^2 \frac{m^2}{V_0^4} \Sigma_i \overline{VN}_i (1 + m/M_i)^{-2},$$

where V_0 is the velocity of the star at the time $t = 0$. For our local star system (if the stars are all of mass, $m = 4 \cdot 10^{33} g$), $\tau = 10^{14}$ years. He studies the case where the initial velocities of the other stars are not neglected, and finds that the motion of the stars of the system will tend to increase the dispersion in kinetic energy and hence to decrease the time of relaxation. He shows that in statistical stellar mechanics, encounters at great distances should be neglected, but the limit of the distance is a function of the relative velocity of the stars, but he cites Charlier's work on the galactic system, which seems opposed to this. A. S. D. M.

1865. Liquid Stars. A. S. Eddington. *Nature,* 121. *p.* 278, *Feb.* 25, 1928.

A criticism of theories advanced by Jeans [see Abstract 300 (1928)]. It appears that ionic jamming must occur according to Jeans' theory when the volume occupied by an ion is as much as 100,000 times the volume of the electronic system. An assumption that this would occur at the high stellar temperatures is unjustifiable, while the suggestion that the intense electric fields would account for the effect is shown in fact to lead to even greater difficulties. Jeans apparently supports his view by his theory that gaseous stars are inherently unstable. The author considers Jeans mistaken in this matter, and sees no insurmountable difficulties in the theory of gaseous stars that would justify acceptance of Jeans' theory of liquid stars.

J. H. Jeans (*ibid.*, p. 279). A reply to Eddington's letter. The author admits the difficulties of the ionic volumes but points out that he assumes only a fractional core of the star to be in the liquid state. Consequently the difficulty stated by Eddington is not so serious. Facts such as the apparent non-existence of stars of solar mass with densities between 1·4 and 50,000 cannot be explained on the gaseous star theory without the aid of numerous *ad hoc* assumptions. A. Wh.

1866. Motion of Magellanic Clouds. W. J. Luyten. *Nat. Acad. Sci., Proc.* 14. *pp.* 241–245, *March,* 1928.

The author states what is known concerning these two objects. He applies Shapley's latest values of their distance to Hertzsprung's suggestion that the progressive changes in their radial velocities is due to perspective effect. He gives two additional methods for determining their proper motions: (1) By observing with the meridian circles stars of the 10th or brighter magnitudes, and the typical cloud-type variables, a method requiring a period of fifty years or more; (2) by determining the motion of the cloud stars relative to faint foreground stars, which is impracticable in this case. He considers the relation of the Magellanic clouds to the Galaxy by means of three hypotheses, all of which are improbable but serve to indicate that the path of the clouds with respect to the Galaxy is not a straight line, and that they may be permanent members (though "cometary" in behaviour) of our system. A. S. D. M.

1867. Two-Drift and Ellipsoidal Stellar Theories. V. Nechvile. *Comptes Rendus*, 186. *pp.* 848–849, *March* 26, 1928.

The author obtains a generalisation of the formulæ of both theories for the case where the apparent motions are greater than a certain positive angular limit ϵ''. For each stellar magnitude m_k, a linear velocity ϵ_k (calculable by means of hypothetical parallaxes) corresponds to the angular ϵ''. In passing from linear to apparent angular velocities it is sufficient to consider their projections, since both spherical and ellipsoidal distributions are retained in projection, and it is only the values of the constants which change with distance and can be calculated by a hypothetical parallax formula. The author finds that the generalisation of Eddington's and of Schwarzschild's formulæ show that the frequency curves given by the ellipsoidal theory take, for certain values of ϵ, forms altogether similar to those of the two-drift theory—a fact favourable to the ellipsoidal theory. A. S. D. M.

1868. Peculiar Bright-Line Spectrum of Ry Scuti. P. W. Merrill. *Mt. Wilson Observat., Contrib. No.* 349. *Astrophys. J.* 67. *pp.* 179–182, *March*, 1928.

Bright hydrogen lines in RY Scuti were discovered at Mt. Wilson in 1921. Spectrograms taken from 1921 to 1927 show a well-marked bright line in the position of the nebular line λ4658. Several fainter lines are apparently associated with it. Their wave-lengths and intensities are 4658·08 (4), 4701·5 (2), 4733·6 (1 +), 4755·0 (1), 4770 (1). AUTHOR.

1869. Renewed Visibility of Hydrogen Emission in the Spectrum of f^1 Cygni. R. H. Curtiss. *Roy. Astron. Soc., M.N.* 88. *pp.* 205–207, *Jan.*, 1928.

Emission was strong in 1904, weak in 1911, 1912, 1915, and in 1921–25, but growing strong in 1926 and 1927; invisible in 1909, 1913, 1916 and 1917–20. The emission of H-Beta in 1927 was narrow and its two components closer together than in 1911. There is no assurance that the spectrum variations of f^1 Cygni are periodic, but it is supported by the variability of the star's radial velocity; if cyclical its period is very long—over twenty-five years. The behaviour of f^1 Cygni makes it probable that a star whose emission has faded out in the time since spectrographic research began will possess it again. In class B stars brightness and temperature are known to be variable, and the atmosphere may be so also whether as the result of "tides" produced by a companion, or from motion through rarefied matter in space, or from pulsatory waves of variable density moving upwards through the atmosphere, or from fluorescence. [See Abstract 1270 (1926).] A. S. D. M.

1870. Relations between the Masses, Luminosities and Spectra of Eclipsing Binaries. G. Shajn. *Roy. Astron. Soc., M.N.* 88. *pp.* 213–224, *Jan.*, 1928.

The mass ratio of 15 eclipsing variables which are spectroscopic binaries is calculated on the basis of the theory of radiative equilibrium. It decreases with increasing difference in brightness. From a discussion of 108 eclipsing binaries it is concluded that the mass ratio is connected with the spectral type of the primary and tends towards unity with advancing type. The primaries belong to the main series, but the secondaries do not afford definite data. The density ratio tends towards unity with advancing type. A. Wh.

LIGHT.

1871. Absorption of Ultra-Violet Light. C. Winther. *Zeits. f. wiss. Phot.* 25. *pp.* 230–232, *March,* 1928.

Outlines a method of utilising a net filter for the measurement of the absorption of ultra-violet light by various glasses. Using a quartz mercury lamp as the light source, a series of spectrograms of the light after passing through the test glass are photographed, with various exposures, on the same plate. Comparison spectra, through the net filter only, are photographed periodically in between the above spectra, with an exposure of 20 seconds, thereby allowing of balance points being obtained. Further spectra, with and without the filter, and excluding the test glass, are photographed below these, to obtain the exponent in Schwarzschild's formula. Using this, together with the balance points obtained, the transmission of the glass for the wave-lengths corresponding to the balance points can be obtained. R. C. F.

1872. Coloration of Pressed Salts. K. Przibram. *Akad. Wiss. Wien, Ber.* 136. 2*a. No.* 7. *pp.* 435–446, 1927.

Further experiments show that rock-salt rendered blue by pressing turns yellow when powdered and again pressed, and then becomes blue in the light. On the other hand, natural blue salt and rock-salt which has assumed a blue colour as the result of irradiation with radium and heating is changed to violet by pressure. These phenomena are related to the increased lability of the colour of the pressed salt. Fluorite and calcite, which are turned blue and yellow respectively by irradiation, become violet if previously pressed. With calcite it is found that pure sliding does not influence the process of coloration. A large number of commercial "chemically pure" salts give pressure-colours, which, in so far as they differ from the colours of the unpressed salts, vary only between violet and turquoise-blue. With many substances, pressure has the same effect on the colorability as ignition or fusion, but with others this is not the case. A sample of potassium sulphate, which without pre-treatment was scarcely coloured by irradiation, turned green if previously fused and solidified, but became violet if pressed instead of melted. The question of activation of impurities by pressure instead of by thermal treatment is discussed. [See also Abstract 2484 (1927).] T. H. P.

1873. Binocular Fusion of Colours and Its Relation to Theories of Colour Vision. S. Hecht. *Nat. Acad. Sci., Proc.* 14. *pp.* 237–240, *March,* 1928.

The modifications of the Young-Helmholtz theory of colour vision proposed by Hering and by Ladd-Franklin to account for the yellow and white sensations produced by mixtures of the red, green and blue sensations were shown with considerable difficulty by Trendelenburg, Rochat and Dawson to be unnecessary. The author explains two methods for binocular vision in which the red and green sensations may be combined with considerable ease to give yellow. In one case two Wratten filters 29 (red) and 58 (green) are held one in front of each eye and a bright white surface viewed, when the yellow sensation results. In the other case the two filters are placed side by side at one end of a long box and a white source viewed through the filters from the other end. The three colours (red, yellow and green) are seen side by side, the central one being due to the binocular fusion of the other two. R. S. R.

1874. Relation between the Sensitivity of the Eye for Threshold Stimulus and the Visual Acuity. P. Lasareff. *Zeits. f. Phys.* **48. 5–6.** *pp.* **437–439, 1928.**

The visual acuity S (reciprocal of angle subtended at the eye by just distinguishable points) and the sensitivity E (reciprocal of the absolute brightness threshold) are shown on the basis of the author's quantum-ionic theory of visual stimulation, to be related by the formula $E = AS^2$, where A is the minimum number of cones stimulated for a threshold perception. E and S are directly measurable, and on making certain plausible assumptions about A, experimental confirmation of the formula is obtained. W. S. S.

1875. Magnification and Night Observation. F. Löhle. *Zeits. f. Phys.* **48. 1–2.** *pp.* **80–91, 1928.**

This paper contains an experimental comparison of the eye accommodation at the telescope with different magnifications and small illumination intensities. H. H. Ho.

1876. Transmission and Reflection of Metal Films. W. V. Houston and G. Moore. *J.O.S.A. and R.S.I.* **16.** *pp.* **174–176,** *March,* **1928.**

The authors describe measurements made on gold and silver films such as are used for interferometer mirrors. Four kathode-sputtered films of different thicknesses were experimented upon, and the transmission measurements made by means of a Nutting spectrophotometer. No great precision was obtained, but two tables of results given clearly indicate that gold films should be used for work above wave-lengths of 6000 Å. Between 5000 and 6000 Å. gold and silver films give approximately equal performances, whilst below 5000 Å. silver films are much superior to gold films. R. C. F.

1877. Possibilities of Reflecting a Complex System. G. I. Pokrowski. *Zeits. f. Phys.* **47. 11–12.** *pp.* **898–903, 1928.**

An expression is obtained for the reflection coefficient of a substance in terms of the radius of the particles composing it, and the relation is extended to a mixture of different substances with different reflection coefficients. This expression holds for particles with radii lying between the wave-length of light and that where the particles are too large for the light to penetrate. The reflection coefficient is measured experimentally for powders by means of a photometric device which allows the object investigated to be compared directly with a strip of varying reflecting power. For coloured bodies light filters with a narrow band of transmission are used. Diffuse light is used and the powder levelled by having glass resting on it. Soot, ochre and ultramarine were used, and the results obtained agree very well with theory. [See also Abstracts 1612 (1925) and 2066 (1926).] R. S. R.

1878. Theory of the Birefringence Induced by Flow in Liquids. C. V. Raman and K. S. Krishnan. *Phil. Mag.* 5. *pp.* 769–783, *April*, 1928.

A theory is developed to explain the birefringence exhibited by a liquid in a state of viscous flow. The magnitude of the effect is found to be proportional to the product of the viscosity and the velocity gradient. The constant of proportionality, which is termed the Maxwell constant for the liquid, is evaluated in terms of the optical and geometrical anisotropies of the molecule, the refractive index, density and molecular weight of the liquid, and Boltzmann's constant. The data for 172 liquids recently obtained by Vorländer and Walter [Abstract 706 (1926)] are critically discussed, and it is shown that the theory succeeds not only in giving an explanation of the general features of the phenomena observed, but also in giving quantitatively the observed values of the Maxwell constant.

A. W.

1879. Vectorial Treatment of Refraction of Skew Rays by a Prism. L. Silberstein. *Kodak Research Lab., Comm. No.* 333. *J.O.S.A. and R.S.I.* 16. *pp.* 88–91, *Feb.*, 1928.

The author shows that the treatment of skew rays (oblique to the edge of the prism) given in optical treatises is considerably simplified by the vectorial treatment proposed in this paper. The treatment is mathematical and cannot be adequately summarised in a short abstract.

A. B. W.

1880. Right-Angled Total Reflecting Prisms. A. Biot. *Ann. Soc. Sci. de Bruxelles*, 48. *pp.* 5–13, *March*, 1928.

The author deals with a certain number of properties peculiar to total reflecting prisms, among which he shows (1) that the angle of deviation of a beam measured in the principal section of the prism is the same as if the beam were reflected on a plane normal to the plane bisecting the angle around which total reflection occurs; (2) while making use of total reflection, one can find the linear dimensions of a distant or inaccessible object, and the method possesses the advantage that difficulties of spherical and chromatic aberrations do not arise; (3) for observers conveniently placed the image shows as a complete reversal of the object; (4) that relations are established which provide the error when the angle of the prism differs from 90° and specify the operations to be performed in applying a new method of verification of the angles. R. S. R.

1881. Cardinal Points of a Thick Lens for Rays which have Suffered Two Internal Reflections. J. P. C. Southall. *J.O.S.A. and R.S.I.* 16. *pp.* 94–112, *Feb.*, 1928.

A brief paper by G. F. C. Searle [see Abstract 636 (1927)] contains the whole theory of this problem, which illustrates in a simple way certain types of optical systems and is an instructive study in geometrical optics. The present paper considers the problem in greater detail and approaches it from a different point of view. The particular method employed is one due to T. Smith (*Phys. Soc., Proc.* 25. pp. 239–244, 1912–1913). A. B. W.

1882. Combination Fringes Applied to the Study of Microscopic Objectives. A. Ciccone. *N. Cimento*, 5. *pp.* 14–25, *Jan.*, 1928.

By means of the method of the fringes of combination of Ronchi a dry microscopic objective of the house of Zeiss was examined, and the results are given of the measurements of the distortion, curvature of the field, astigmatism, and aplanatism. The chromatic aberrations were not measured because they were extremely feeble. The general method of Ronchi consists in causing to fall the magnified image of a diffraction grating, given by the objective, upon a photographic network of convenient period, and in observing and photographing at different distances the combination fringes, using a fine and intense luminous pencil which follows the optic axis or deviates from it by a determined angle variable at will. The author gives a diagram exhibiting the details of the experimental arrangement and discusses it theoretically. Tables are given summarising the results, and it appears that these establish a practical method (derived from the general one of Ronchi) for the complete study of the properties and aberrations of microscopic objectives. J. J. S.

1883. Behaviour and Use of Diffraction Fringes in the Control of Optical Systems. V. Ronchi. *Rev. d'Optique*, 7. *pp.* 49–67, *Feb.*, 1928.

The author gives first a method for deducing the expression for the fringes produced by a grating and leads on to the equation of the wave surface. Assuming next that the wave is spherical, the aberration of the wave is found, and this case is then extended to a spherical surface of reference. Angular aberrations, transverse and longitudinal, are expressed as a function of the characteristic $\Delta(h)$ and the properties of fringes along the meridional section of the wave are discussed. The features of fringes shown in an interferogram in the case of waves of revolution around the axis are discussed, and the results are applied to the case of the simplest spherical aberration. Measurements carried out in a certain case are described. Finally, diffraction fringes produced by a grating and more complex waves are examined. R. S. R.

1884. Spectrograph Slit. A. de Gramont. *Rev. d'Optique*, 7. *pp.* 68–71, *Feb.*, 1928.

Particulars are given of the mechanical features and adjustments for a new pattern slit which is to be fitted to the large spectrograph at the magneto-optical laboratory of research installed at the National Office of Research and Inventions. The jaws of the slit are carried on bronze supports, one of which is fixed and the other can be rotated by a micrometer screw. The jaws remain parallel during the rotation, and their distance apart is indicated directly by the readings on the micrometer. The arrangements of the slit are illustrated by diagrams and photographs. R. S. R.

1885. The Ondoscope. *Rev. d'Optique*, 7. *pp.* 72–79, *Feb.*, 1928.

This apparatus, due to E. Charron, is arranged to show by stroboscopic projection with considerable ease and clearness the propagation of waves of all kinds at the surfaces of liquids, such related phenomena as reflection and refraction at various contours and at the common boundary of two dissimilar liquids, interference and diffraction. The ideas of astigmatism and caustics are also illustrated. The apparatus is useful also for projection of photographs, or objects situated in a horizontal plane, liquids in thin layers used for surface tension, electrolysis or crystallisation. Particulars are given of the optical arrangements employed and of the means employed to eliminate waves in the liquid surfaces caused by the stroboscopic motor or vibrations of the vessel support. R. S. R.

1886. New Interferometer Method for Measuring Wave-Lengths and its Application to the Preliminary Determination of the Krypton Lines for the German Addition to the Length of Light Waves. A. P. Weber. *Phys. Zeits.* 29. *pp.* 233–238; *Disc.*, 238–239, *April* 15, 1928. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

The author enumerates the various disadvantages of the old standard which gave an error of ± 0·001 Å. to 0·004 Å. An apparatus is then described by means of which a much higher accuracy is obtained. During the optical measurements, values of atmospheric pressure temperature and humidity were obtained, temperatures being accurate to ± 0·003° C. The apparatus consists essentially of a suitably modified Michelson interferometer with the usual Fizeau bands. A uniform distribution of intensity along the fringes is obtained, and measurements are equally good in the ultra-violet. The various advantages are enumerated. An accuracy of $1 : 4 \times 10^7$ is possible or of 0·00015 Å. for $\lambda = 6000$ Å. Tables set out the wave-lengths obtained for four Kr lines and one each of Cd and Ne. R. S. R.

1887. Treatment and Testing of Observations by Wave-Length Methods. C. V. Drysdale. *Phot. J.* 68. *pp.* 106–117, *March*, 1928. *Traill-Taylor Memorial Lecture.*

The author deals first with the theoretical side and employs the wave method to obtain formulæ for (1) a thin lens and (2) lens systems to account for chromatic and spherical aberrations. In the former central and marginal chromatic aberrations are calculated, while for the latter central spherical aberration, coma, radial astigmatism, curvature of the field and distortion are examined. The Huyghen eyepiece is used to illustrate these relations. The Petzval condition for flattening the field and the Rudolph principle of opposed graduations of refractive indices are considered, and the satisfaction of the latter by anomalous or Baryta glass. These relations are then shown in their application to the design of optical systems. In the last part of the paper the testing of optical systems using (1) the Hartmann test, (2) Beck's microscope method, and (3) the lens testing interferometer are explained in some detail . In the calculation of aberrations the last-named method is usually slow and complicated, but a simplified method is described for the measurements. R. S. R.

1888. Production of Anisotropic Surfaces. H. Zocher and K. Coper. *Zeits. f. phys. Chem.* 132. 3–4. *pp.* 295–302, *March*, 1928.

The anisotropy produced by rubbing a glass surface is a property of the pure surface, and can only be removed by etching away the surface. The mechanical action was thus shown to have a maximum depth of 0·0003 mm. The anisotropy is detected by dichroism in light reflected from an adsorbed layer of methylene-blue, but other colours can also be used. T. M. L.

1889. Anisotropy Produced in Photochlorides by the Weigert Effect. H. Zocher and K. Coper. *Zeits. f. phys. Chem.* 132. 3–4. *pp.* 303–312, *March*, 1928.

Anisotropy was produced in a photosensitive film of silver chloride by exposing it to polarised light, although, unlike Weigert's experiment [see Abstract 570 (1920)], no binding material was used, since the film was obtained by the direct action of chlorine on a silver mirror on glass. Negative results were obtained with other photosensitive substances, *e.g.*, asphalte, bichromated gelatine, and thallous chloride (gold chloride proved not to be photosensitive), but a strong effect was obtained with cuprous bromide. T. M. L.

1890. Production of Optical Activity by Circular Light. H. Zocher and K. Coper. *Zeits. f. phys. Chem.* 132. 3–4. *pp.* 313–319, *March*, 1928.

A detailed description is given of a procedure whereby circular dichroism and circular double refraction, as indications of optical activity, can be developed by the action of circularly polarised light on a film of photosensitive silver chloride. T. M. L.

1891. Polarisation of Light from Canal Rays in Weak Electrical Fields. Part I. The Rate of Extinction of H_β in a Transverse Field. E. Rupp. *Ann. d. Physik*, 85. 5. *pp.* 515–528, *March* 19, 1928.

The polarisation ratio I_p/I_s in weak fields has been determined for different field intensities and different velocities of the canal rays. The curves for I_p/I_s show peculiar periodical fluctuations along the path of the canal ray; the number of the periods increases with diminishing canal-ray velocity and with increasing electrical field. The phenomena are explained qualitatively by considering the vibrations of a classical anharmonic oscillator moving along the path of the beam, with different phases of vibration at different points in its path. H. N. A.

1892. Anomalous Kerr Effect in Sodium Vapour. A. Bramley. *Frank. Inst., J.* 205. *pp.* 539–547, *April*, 1928.

The author measured the Kerr effect (K) at 2000 and 1000 volts/cm. for Na vapour corresponding to equilibrium with Na at 130° C. and 350° C., the observed rotations being plotted as a function of temperature. Generally the rotation decreases with rise of temperature, changes sign, and then increases. He found $K = 0$ for $V = 2000$ volts/cm. at 220° C., and for $V = 1000$ volts/cm. at 275° C. The quantum theory of the Kerr effect cannot account for the phenomena at low temperatures where the rotation is small because it cannot account for anomalous dispersion. Modifications of Voigt's theory by the introduction of the probabilities of transitions from the two new energy states of the Stark pattern leads to a more satisfactory explanation of the results obtained, while data on radiation scattering in magnetic fields should give information on the probable coefficients in the electric fields. Datta also showed that resonance radiation increased as the temperature fell, and at low field strengths the percentage of radiation polarised is much greater than expected and may equal that of much greater fields at these temperatures, 135° C. [See also Abstract 1677 (1921).] R. S. R.

1893. Electro-Optic Theory of Quartz. R. de Mallemann. *Comptes Rendus*, 186. *pp.* 853–855, *March* 26, 1928.

The author postulates that crystalline quartz is formed by the juxtaposition of reticular planes, occupied by anisotropic molecules of SiO_2, of which the orientation is identical throughout each plane, but changes by 120° in successive planes. A force P acting along a binary axis will then deform the lattice, making it monosymmetric; but the relative variations of length will be the same in two directions at right angles. The layers of molecules oriented at ± 120° to the force will then turn through a small angle $\Delta\alpha$ given by $2\Delta\alpha/\sqrt{3} = \mathrm{P/E}$, where E is the value of Young's modulus. The piezoelectrical effect is attributed to a permanent ("structural") electric moment μ of the molecules, which gives rise to a polarisation $\frac{1}{2}\mathrm{N}\mu\sqrt{3}\Delta\alpha$, and can be calculated from the Curie constant A and Young's modulus E as follows: $\mu = 2\mathrm{AE/N} = 3{\cdot}7 \times 10^{-18}$. This value is comparable in magnitude with those calculated for organic molecules from variations of their dielectric constants. Conversely, an electric field h, applied to the crystal in the direction of a binary axis, will produce a couple $\mu h \sin \alpha$, which will cause a rotation of the molecules and a deformation of the lattice $\mathrm{P/E} = \mathrm{A}h = 6{\cdot}4 \times 10^{-8}h$. The product AE is the longitudinal mechanical equivalent of the electric field in the quartz. Finally, the rotation $\Delta\alpha$ of the molecules gives rise to an inherent birefringence, which is at first proportional to the field, but in very strong fields it will vary more rapidly on account of the Kerr phenomenon of induced polarisation, and thus give rise to terms in $\Delta^2\alpha$. If δ is the anisotropy of the molecule in a plane normal to the axis the difference of refractive indices in the weaker fields where the effect is still linear is given by $n_1 - n_2 = 2\pi\mathrm{N}\left(\frac{n^2+2}{3}\right)^2 \delta \times 6{\cdot}4 \times 10^{-8}h$. The recent measurements of N. T. Ze [see Abstract 1710 (1928)] give $n_1 - n_2 = 2{\cdot}3 \times 10^{-8}h$, whence $\delta = 1{\cdot}55 \times 10^{-24}$. This is a perfectly normal figure, since the reduced refractivity of quartz is $2{\cdot}94 \times 10^{-24}$, or a relative anisotropy of 0·25. These data can be used to calculate the rotatory power, but this calculation is deferred to a subsequent communication. T. M. L.

1894. Anomalous Dispersion in Excited Gases. Part I. Proof of the Dispersion Formula of the Quantum Theory. R. Ladenburg.

Zeits. f. Phys. 48. 1–2. *pp.* 15–25, 1928.

Derives a formula which gives, with a satisfactory degree of approximation, the value of $n - 1$ in the immediate neighbourhood of an isolated spectral line. One term of this formula corresponds to the number of the dispersing electrons in the classical theory, and is equal to $\mathrm{N}_j f_{kj}\left(1 - \frac{\mathrm{N}_k}{\mathrm{N}_j}\frac{g_j}{g_k}\right)$; the portion in brackets accounts for the so-called negative dispersion, which corresponds to the negative absorption of the radiation theory of Planck and Einstein; N_j and N_k are the atomic densities in the states j and k; g_j and g_k are the corresponding statistical weights; f_{kj} is the "strength" of the oscillators for the transition $k \rightarrow j$. It is shown by referring to existing experimental data that the theoretical relation $f_{kj} = \mathrm{A}_{kj}\frac{g_k}{g_j}\frac{mc^3}{8\pi^2 e^2 \nu_{kj}^2}$, where A_{kj} is Einstein's probability of transition, holds exactly for the D sodium lines. It is shown how probabilities of transition and densities of excited atoms can be determined by measurements of the anomalous dispersion, and the conditions under which the influence, which is generally small, of negative dispersion may be detected are defined. H. N. A.

1895. Anomalous Dispersion in Excited Gases. Part II. Anomalous Dispersion in Excited Neon. H. Kopfermann and R. Ladenburg. *Zeits. f. Phys.* 48. 1–2. *pp.* 26–50, 1928.

Two long tubes of neon, one of which had two electrodes in side tubes near the ends, were placed one in each of the two beams of a Jamin interferential refractor; the beams after their reunion passed into a spectrograph with a plane grating, and a system of horizontal interference bands parallel to the length of the spectrum were formed, the distortions of which in the neighbourhood of the spectral lines made it possible to determine the anomalous dispersion (a.d.) in the case of twenty $s_5 - p_k$, $s_4 - p_k$, $s_3 - p_k$ lines in the red-yellow. Continuous current was used to excite one neon tube, which was filled throughout its length by the positive glow. The a.d.—that is to say, the number of atoms in the s_5, s_4 or s_3 state—increases with the current at a rate which depends on the state, but soon approaches a saturation value, which is almost reached with a current of 50 mA. This is due to the way in which the s_i atoms are formed and destroyed by collisions with electrons; the observations on the metastable s_5 and s_3 atoms, and approximately those on the unstable s_4 atoms, can be represented by the formula $N_s = aJ/(bJ + c)$, where J is the current and *a*, *b*, *c* are respectively formation and extinction factors independent of the current; for saturation $\overline{N}_s = a/b$. With increased pressure above 1·3 mm. $\overline{N}_s$ diminishes and saturation takes place at constantly lower currents. With constant current and increasing pressure the effect of the exciting electrons with moderate velocities remains nearly constant or diminishes, while the slow electrons, which destroy the excited atoms by collision, for different reasons increase in number; thus *b* increases with the pressure faster than *a* and considerably faster than *c*. The behaviour of the s_4 atoms is also discussed. H. N. A.

1896. Anomalous Dispersion in Excited Gases. Part III. Probability of Transition and Density of Excited Atoms in Neon. Statistical Equilibrium in the Positive Column. H. Kopfermann and R. Ladenburg. *Zeits. f. Phys.* 48. 1–2. *pp.* 51–61, 1928.

Calculates the relative oscillator strengths f_{kj}, and the probabilities of transition A_{kj}, of lines with the same final state *j*, from the measurements of the anomalous dispersion in neon recorded in Part II. These relative values are to a remarkable degree independent of the current and pressure. Using the relative measurements of intensity of Dorgelo, suitably combined with the authors' measurements of the anomalous dispersion, the relative atomic densities in the states s_5, s_4 and s_3 are calculated by means of the theory developed in Part I. The relation of the number of atoms $Ns_5 : Ns_4 : Ns_3$, with increasing current and independently of the pressure, approaches the value 100 : 60 : 20 of statistical equilibrium which holds at very high temperatures. Using this value, the A values of all the lines measured have been calculated in relation to the 6402 line. The above result is also arrived at by means of the *f* summation law, without using the measurements of intensity. The absolute values of the oscillator strengths, the probabilities of transition, the durations of life and the atomic densities of the excited *s* states have been estimated in this way. H. N. A.

1897. Anomalous Dispersion in Excited Gases. Part IV. Anomalous Dispersion of Hydrogen. True Ratio between the Intensi-

ties of the Lines H_α and H_β. Agathe Carst and R. Ladenburg. *Zeits. f. Phys.* 48. 3–4. *pp.* 192–204, 1928.

The method employed is similar to that used in Part II with neon, though difficulties arose in keeping the excited tube filled with atomic hydrogen at a high and constant concentration. Tubes of Jena glass and of quartz were employed; both of these under certain circumstances favour the recombination of the atomic hydrogen to the molecular form, and glass tubes which at first worked well had afterwards to be replaced for this reason. Continuous current between 0·2 and 1 amp./sq. cm. was employed, and the effect of the anomalous dispersion of H_α and H_β was photographed and measured. The ratio between the numbers of the dispersion electrons for the two lines was found to be 4·7. To a first approximation this ratio is, according to the dispersion formula of the quantum theory, equal to that between the "strengths" of the corresponding quantum transferences f_α/f_β, and essentially to that of the probabilities of transference; for this the value 5·37 has been calculated by means of quantum mechanics. The difference between the above numbers is rather greater than the probable observational error, and may be explained as being due to negative dispersion (see Part I). It seems probable that this should not be neglected in the case of strongly excited hydrogen, as has been done above in assuming that the number of dispersion electrons and the "strength" of the quantum transferences are proportional to one another. H. N. A.

1898. Dispersion by Hygrogen-Like Atoms in Undulatory Mechanics. B. Podolsky. *Nat. Acad. Sci., Proc.* 14. *pp.* 253–258, *March*, 1928.

In order to apply the theory of dispersion developed by Schrödinger to the experimental results obtained for atomic hydrogen the wave equation was obtained by the operational method of Schrödinger and Eckart, as extended by Epstein, and in this way it is free from terms of the relativistic correction order. The formulæ obtained give for $v = 0$, $n^2 - 1 = 9NL^6/32\pi^5e^6\mu^3K^4$, a result in exact agreement with that obtained for the dielectric constant by van Vleck, Epstein and Pauling. The results are not in very good agreement with Langer's determinations [see Abstracts 974 and 975 (1927)] for H_2, but the experimental difficulties are great. R. S. R.

1899. Interference of Light Quanta. A. Proca. *J. de Physique et le Radium*, 9. *pp.* 73–80, *Feb.*, 1928.

Up to the present, in calculating the general conditions for quanta, only the space coordinates have been employed and the time coordinate has been neglected. The author shows that, if all four coordinates are considered, one obtains for an atom in the stationary state the classical quantum conditions which define the energy levels. For a Bohr atom which emits and absorbs in a permanent *régime* the same conditions are obtained, with the addition of another which expresses the fact that the light emitted and absorbed is coherent, *i.e.*, it is capable of producing interference. Between an emission and the consecutive absorption, and also between two emissions, the time elapsing is a whole multiple of the period of the light emitted or absorbed, so that the distance between two quanta emitted is a whole multiple of a wave-length; statistically the appearance of the interference fringes will then be the same as according to the wave theory. All this is worked out mathematically by means of the theories of Brillouin and of Schrödinger. H. N. A.

1900. Sensitometry of the Bichromated Gelatine Process. A. C. Hardy and F. H. Perrin. *Frank. Inst., J.* 205. *pp.* 197–219, *Feb.*, 1928.

The authors, having followed the technique recommended by Mees for this process, found that minor improvements could be effected in the method. A full description of the new method used by them in the remainder of their investigation is given in the first part of the paper, followed by the theory of the process. Having decided on a definite procedure, they carried out a series of experiments on plates so sensitised, but varied certain factors one at a time. They tried the effect of varying the concentration of the sensitiser; the sensitising conditions; storing the plates after sensitising and after exposure; and etching, washing and dyeing conditions. The results obtained are clearly shown by graphs. The method they adopted proved to be the best, and also, although large variations in reproducibility were obtained, these variations were not too great for practical work. Finally, the application of the process to two-colour pictures is discussed. R. C. F.

1901. Interchangeability of Zinc Oxide and Various Dyes in Optical Sensitisation. C. Neuweiler. *Zeits. f. wiss. Phot.* 25. *pp.* 187–224, *March*, 1928.

In the first part of the paper experiments carried out on zinc oxide and aqueous dye solutions mixed together, and also with anode depolarisers, such as cane-sugar, glycerine and benzidine, are described. Air was exhausted from the solutions and then they were exposed to a high candle-power source of light until bleaching occurred. From the results on various vat and azo dyes it is shown that, when illuminated, zinc oxide reacts on all dye solutions, both oxidising and reducing them, but with anode depolarisers present only reduction takes place. Photolysis occurs with vat dyes, whilst with azo dyes the photolytic reductions are not reversible. Temperature and alkalinity of the zinc oxide play no part at all. The second half of the paper deals with similar experiments on dye solutions only, using the same anode depolarisers as above. It is concluded from these latter experiments that dyes can exert the same photolytic action, under certain conditions, as zinc oxide. Dye sensitising limitations are given, showing that the sensitisors must be in optical opposition, in a definite manner, to the acceptors. The effective combination is obtained when the absorption ranges of both sensitiser and acceptor, for short wave-lengths, are contiguous. Separation only retards the effect, as does contact at the long wave-lengths. R. C. F.

1902. Solarisation of Silver Bromide. Lüppo-Cramer. *Zeits. f. wiss. Phot.* 25. *pp.* 224-229, *March*, 1928.

In order to indicate the wide differences between modern plates, with reference to solarisation, a number of densographic curves for various makes of plates are given. Some of these curves remain horizontal for some time and then decline, whilst others increase and then decrease without the neutral state, as represented by the horizontal portion, being shown. A further series of curves is also included showing the effect on the solarisation of impregnating the plates with various solutions, illustrating the fact that nitrite and other bromide-acceptors operate in a similar manner. R. C. F.

1903. Chemical Effects of Radiation. M. P. Villard. *Phot. J.* 68. *pp.* 118–121; *Disc.*, 121–122, *March*, 1928.

The author refers first to several experiments already known in which light can destroy the X-ray impression on a photographic plate and can re-establish very nearly, if not completely, the original X-ray sensitivity, and red light can destroy the latent image of violet light. He concludes that the X-ray effect is due to the removal of an electron from an inner ring of the atom (ionisation), or its displacement to another level, *e.g.*, one of the "virtual" levels usually unoccupied. These ions or electrons facilitate the condensation of mercury vapour and are in fairly stable equilibrium. Ordinary light affects electrons in the outer orbits, and these displaced electrons may at once restore the inner orbits. All wavelengths serve for this purpose, but ultra-violet light, having larger quanta, is more efficient. Experiment confirms the view that the latent images produced by ordinary light and X-rays are at different atomic levels, and either is capable of independent development or destruction. In the *Discussion*, **S. Price** asked how an image could be obtained on using a developer if X-rays affect only the inner rings of the atom, while chemical reactions are concerned with the outer valency orbit. R. S. R.

1904. Primary Standard of Light. C. Müller. *Zeits. f. Phys.* 47. 11–12. *pp.* 751–760, 1928. *From the Reichsanstalt.*

The author suggests as a standard of luminous intensity the adoption of a specified area of a "black body" radiating a specified amount of total energy. He shows that a change of 1 % in the light output corresponds with a change of about 4 % in the energy at a temperature of about 2360° K, the colour temperature of the tungsten filament vacuum lamp. The chief difficulty lies in the absolute measurement of the energy, the elimination of stray radiation and the proper use of an absolute thermopile. A modified form of thermopile is described in the paper, as it was used by the author in his determinations of Stefan's constant. J. W. T. W.

1905. Fluorescent Ultra-Violet Photometer. W. T. Anderson, Jr., and E. Gordon. *J.O.S.A. and R.S.I.* 16. *pp.* 224–230, *March*, 1928.

Describes a simple form of fluorescent ultra-violet photometer which will serve as a reliable and fairly accurate means of measuring the intensity of ultra-violet light. The photometer consists of a device whereby the yellow-green fluorescence emitted by a uranium glass screen, when illuminated by ultra-violet light, can be balanced against the light from a ground white glass screen, when illuminated by an electric lamp. Light from both screens passes through a monochromatic green filter to the eyepiece. The calibration is a very complicated procedure, owing to the difficulty of measuring the total ultra-violet light, which falls on the photometer slit, from the light source. An involved method of calibration is described, the photometer being calibrated against each light source with which it will be used. It is only necessary to calibrate one instrument by this method, all others being calibrated by comparison with this standard against the various light sources specified. R. C. F.

1906. Influence of the Walls on Gas Phosphorescence. Maria Majewska and W. Bernhardt. *Zeits. f. Phys.* 48. 1–2. *pp.* 137–140, 1928.

As a supplement to the work of Herzberg [see Abstract 1348 (1928)] on the phosphorescence of nitrogen and oxygen and the influence of the walls thereon, a few of the authors' previous results are given again. It is not sufficient to choose the pressure and excitation conditions; the tube must be "prepared" in a definite way. It is concluded that the walls are covered with some unknown gas (possibly N_2O_5) which catalytically decomposes the gas in the tube. J. E.

1907. Photoluminescence of Uranyl Salts. S. J. Wawiloff and W. L. Lewschin. *Zeits. f. Phys.* 48. 5–6. *pp.* 397–425, 1928.

The luminosity of uranyl salt crystals, uranium glass and liquid solutions dies away according to the law $I = I_0 . \epsilon^{-t/\tau}$. A short ultraviolet stimulation is followed in some substances by a second dying-away. In all the cases examined there was phosphorescence but no fluorescence. The time of dying-away in solutions depends within wide limits on the temperature and on the concentration, the exponential law being followed and I_0 remaining constant; τ is therefore proportional to the light-sum. The decay is also affected by the viscosity of the solution. The photoluminescence corresponds to a change from the metastable condition of the stimulated molecule. A. D.

1908. Kundt's Displacements in Absorption Spectra. P. Vaillant. *Comptes Rendus*, 186. *pp.* 755–757, *March* 19, 1928.

In continuation of previous work [see Abstract 307 (1928)], solutions of erythrosine and malachite green have been measured with a spectrophotometer, both water and benzene being used as solvents. In the first case both bands are displaced without deformation as the solvent is changed, while in the second case the bands behave independently and react separately upon the remainder of the spectrum. F. S.

1909. Alteration of the Absorption Coefficients with the Temperature in the Short-Waved Ultra-Violet Red for Fluorite and Quartz. O. Reinkober and H. Kipcke. *Zeits. f. Phys.* 48. 3–4. *pp.* 205–215, 1928.

The results are given of measurements of the absorption coefficients for fluorspar for wave-lengths between 8 μ and 12·5 μ and for quartz between 3 μ and 6·5 μ at temperatures between the ordinary temperature and that of liquid air. The absorption diminishes as the temperature falls, simple extrapolation indicating the existence of a fundamental absorption at the absolute zero of temperature. For the range of wavelength examined, the influence of change of temperature on the absorption diminishes linearly with the wave-length for fluorspar, but with quartz it shows accelerated increase as the region of principal absorption is approached. T. H. P.

1910. Absorption Bands of Organic Dyes. W. E. Speas. *Phys. Rev.* 31. *pp.* 569–578, *April*, 1928.

The forms of the absorption bands of solutions of rhodamin-B and eosin at different concentrations and temperatures have been investigated with a Lummer-Brodhun spectrophotometer. Solutions of fluorescein, uranine and resorcinol-benzein at various temperatures have also been measured. It is found that increase of concentration has the same general effect as lowering of temperature. A concentrated solution of rhodamin-B shows two prominent bands which vary unsymmetrically with concentration. The effects of these two factors in the other cases are discussed in detail. A theory of Merritt concerning the form of bands has been tested and verified for dilute aqueous solutions of rhodamin but not for other solutions. F. S.

1911. Broadening of Absorption Bands by Pressure. M. C. Teves. *Zeits. f. Phys.* 48. 3–4. *pp.* 244–258, 1928.

The vapours of benzole, orthodichlorbenzole and paradichlorbenzole were examined in a steel tube, with quartz windows at the ends, designed to withstand pressures up to 200 atmospheres; a small amount of the substance was introduced and the absorption spectrum of its vapour was photographed. A gas, which was generally nitrogen, was then introduced, the pressure of which was gradually raised to 150 atmospheres, the absorption spectrum being photographed at a number of different pressures. At a pressure of 5 atmospheres a broadening of the rotation lines was observed, and at 10 atmospheres, with the optical arrangement employed, these lines had run into one another and could not be seen. As the pressure increased the band heads were also broadened, at first without a measurable shift in position. A shift could be measured at 20 atmospheres, which increased with the pressure, being the same for benzole and orthodichlorbenzole and greater for the para compound. Finally, the component bands ran together to form broader bands. The absorbed energy increased greatly with the pressure of the foreign gas. New bands also appeared as the pressure increased. The appearances are explained by means of the Lorentz collision theory up to a pressure of 10 atmospheres. For higher pressures it is necessary to consider analogies with the Stark effect for atoms, though in part these seem to be of quite a different order of magnitude. No direct connection with the polarisation has been found.

H. N. A.

1912. Absorption and Scattering of Mercury Vapour for the Line 2536. J. Z. Zielinski. *Phys. Rev.* 31. *pp.* 559–568, *April*, 1928.

A beam from a mercury arc is passed through a vessel filled with mercury vapour of 16·2° C., and excites in it resonance radiation of wavelength 2536. The absorption coefficient and the scattering coefficient of this radiation have been measured. It was found that: (*a*) the absorption coefficient is 1 cm.$^{-1}$ and is not changed measurably by the admission of air up to 4-mm. pressure, although the resonance radiation is strongly quenched by the air; (*b*) in vacuum the scattering coefficient is equal to the absorption coefficient within the limits of the experimental error. This proves the assumption first made by Wood that in vacuum there is no true absorption, but that the whole loss of energy is due to scattering. For higher pressures the scattering coefficient diminishes. The data found are in good agreement with previous direct measurements of Wood and Stuart. AUTHOR.

1913. New Effects in the Optical Excitation of Vapours. R. W. Wood. *Frank. Inst.*, *J.* 205. *pp.* 481–495, *April*, 1928.

I. The variation in intensity of the lines emitted by mercury vapour when excited by the total radiation of a water-cooled mercury arc is explained, assuming successive absorptions and emissions. Using the photographic method, photometric comparisons of the intensities verified the prediction that lines resulting from a two-stage absorption increased with the square, lines resulting from a three-stage absorption with the cube of the intensity of the exciting light. Any apparent contradiction to the conservation of energy implied by this statement is readily explained when account is taken of the absorption of the inciting beam by the initial layers of the vapour, and, in fact, with increasing intensity of the incident radiation, the volume fluorescence merges into a surface fluorescence. II. Some further experimental evidence is submitted in regard to the green fluorescence of mercury vapour excited by the light of the spark between terminals of Al, Zn, etc. III. In exciting iodine vapour with the light of the mercury arc, it is found that the presence of helium develops a number of bands of the iodine spectrum, containing, however, only half as many lines as would be found in the corresponding band of the absorption spectrum. The failure of the alternate lines is discussed theoretically and the conclusion drawn that during collisions of the second kind the rotational quantum number of an iodine molecule can change only by an even number. This is in accord with the new mechanics, although incomprehensible on the older Bohr-Lenz theory. W. S. S.

1914. Band Spectrum of Water Vapour. Part II. D. Jack. *Roy. Soc., Proc.* 118. *pp.* 647–654, *April* 2, 1928.

Following up previous work [see Abstract 2913 (1927)], new measurements are now submitted for the band λ3428. In agreement with the scheme given previously, it is established that the initial terms of the bands λλ3428 and 3064 are the same, and that the final terms of the bands λλ3428, 3122 and 2875 are the same. Moments of inertia are computed for all the bands and replace the relative values of the earlier paper. For the vibrationless state $I_0' = 1{\cdot}633$, $I_0'' = 1{\cdot}498$, in units 10^{-40} gm. cm.^{2} For the case of the OH ion the corresponding nuclear separations are $r_0' = 1{\cdot}022 \times 10^{-8}$ cm. and $r_0'' = 0{\cdot}979 \times 10^{-8}$ cm.

W. S. S.

1915. Spark Spectrum of Argon. T. L. de Bruin. *Zeits. f. Phys.* 48. 1–2. *pp.* 62–66, 1928.

Gives the deep quartet terms of the ArII spectrum, and shows that there is a close analogy between the spectra of NeII and of ArII. Considers first the combinations of $^4P_1$, $^4P_2$ and $^4P_3$ with $^4P_1'$, $^4P_2'$ and $^4P_3'$ terms, giving the wave-lengths and wave numbers for the two spectra; gives details of the combinations between the deepest quartet terms, including their intensities, wave-lengths, observed and calculated wave numbers, and the intensities of the corresponding helium lines. Seven lines are listed under $^4P_{123} - {}^4P_{123}'$, including $^4P_1 - {}^4P_2'$, $^4P_2 - {}^4P_3'$; eight under $^4P_{123} - {}^4D_{1234}'$; three under $^4P_{123} - {}^4S_2$; eight under $^4D_{1234}' - {}^4P_{123}$, and ten under $^4D_{1234}' - {}^4D_{1234}$. The measurements used, with one exception, are by Kayser. The final table gives the experimental terms, the term values, the differences between consecutive term values, the atomic configurations, and the theoretical term symbols for neon II and argon II. Three ^4P terms, three $^4P'$ terms, four ^4D terms, one ^4S term and four $^4D'$ terms are included for each gas. H. N. A.

1916. Spark Spectrum of Neon. H. N. Russell, K. T. Compton and J. C. Boyce. *Nat. Acad. Sci., Proc.* 14. *pp.* 280–283, *March*, 1928.

A new series of lines between 462 Å. and 353 Å. has been found using electron impacts at controlled voltages between a Wehnelt kathode and a wire grid anode. The work of de Bruin [see Abstract 1270 (1928)] has been extended so that 203 lines have been arranged in 59 multiplets. Tables are given of new lines, term values and mean quantum defects. An ionisation potential of 40·9 ± 0·05 volts is deduced. F. S.

1917. Measuring Spectrum Photographs. W. Hirschel. *Zeits. f. Phys.* 48. 3–4. *pp.* 293–294, 1928.

The plate to be measured is put in contact with a photographic reproduction of a mm. scale in which the lines are about 0·04 mm. apart. Under suitable magnification the scale again appears with apparent spacing of 1 mm. and measurements can be made to 0·01 mm. F. S.

1918. Afterglow of Nitrogen. J. C. McLennan, R. Ruedy and J. M. Anderson. *Nature,* 121. *pp.* 537–538, *April* 7, 1928.

Active nitrogen is capable of exciting lines from metallic vapours corresponding to about 11 volts. It will not, however, excite lines due to xenon either in the pure gas or when mixed with krypton. The λ8819 Å. line of xenon is known to be strongly absorbed in excited xenon, but was not weakened in the nitrogen mixture, showing that no xenon atoms were in a metastable state. It is concluded that chemiluminescence plays a rôle in phenomena associated with active nitrogen. F. S.

1919. Afterglow of Nitrogen and Oxygen. K. Stöck. *Zeits. f. Phys.* 48. 5–6. *pp.* 358–359, 1928.

Herzberg has recently observed the afterglow in an electrodeless ring discharge in air [see Abstract 1348 (1928)]. The author has also observed it in the side tube of an ordinary Geissler tube. It appears at pressures greater than 2·8 mm., but suddenly vanishes at this point. F. S.

1920. Proper Frequencies in the Ultra-Violet of Some Crystals, in Themselves and in Phosphores. R. Hilsch and R. W. Pohl. *Zeits. f. Phys.* 48. 5–6. *pp.* 384–396, 1928.

The object of the continued experiments [see Abstract 96 (1928)] is to investigate whether the sharp bands, *e.g.*, of TlCl (ascribed to the ultra-violet dispersion-electrons of this salt), are observed when traces of such salts are added to phosphores of the alkali-halide type. These additional halides of Tl, Pb, Ag must have a high refractive index and be good photo-electric conductors. 100 gm. of KCl are, for instance, mixed with 47 mgm. of TlCl and fused; only 1 % of the addition is really taken up. The authors study first the pure salts in layers of about 0·01 μ thickness, produced by drawing the melt between two quartz plates, which are then compressed. The resulting films are by no means of uniform thickness, unless the quartz plate be optically plane. The absorption constants K (of the order of 10^5 mm.$^{-1}$) are defined by $J = J_0 e^{-Kd}$, where d is the thickness in mm. Lowering of the temperature to − 193° [see Lorenz, Abstract 914 (1928)] did not narrow the bands much, but cooling of the alkali halide facilitated the measurements on the mixtures, and it was found that the two or three energy levels determined in the salts of Tl, Pb, Ag could be traced in the extremely fine dispersions of these metal ions in the phosphores. H. B.

1921. Series Spectra of Potassium and Calcium. I. S. Bowen. *Phys. Rev.* 31. *pp.* 497–502, *April,* 1928.

Several of the strongest extreme ultra-violet lines in the K_{III}, K_{IV}, Ca_{IV}, and Ca_V spectra are given their series designation. In K_{II} several lines are identified in addition to those found by de Bruin. The absolute value of the terms of K_{II} are determined, thus fixing the ionisation potential at 31·7 volts. 137 lines are classified in Ca_{III} and the term values of the levels involved are calculated. These correspond to an ionisation potential of 51·0 volts.

1922. Cyanogen Tail Bands. F. A. Jenkins. *Phys. Rev.* 31. *pp.* 539–558, *April*, 1928.

Photographs were taken with the Rowland grating previously used [see Abstracts 342 (1928)] and exposures of 5 to 13 hours given. Wave-numbers and intensities are given for lines in 13 CN tail bands as excited by the reaction of acetylene with active nitrogen. Each band has a doublet P and a doublet R branch like the stronger violet CN bands, but the doublet separations vary markedly. The tail bands are shown to be high—*n* members of the ordinary CN sequences. Some new features of the band-spectrum structure are described, and are discussed in relation to Mulliken's predictions. F. S.

1923. Intensities in the Hydrogen Spectral Series. F. G. Slack. *Phys. Rev.* 31. *pp.* 527–532, *April*, 1928.

The absolute intensities of the components of the most important lines of the first six series in the spectrum of the hydrogen atom as computed on the basis of the wave mechanics are tabulated. The components are summed to give the total line intensities per atom in the initial state. The probability coefficients for the components and lines are also tabulated. The results of comparison between experiment and theory are briefly discussed and an experiment for giving values more directly comparable with the calculated values is suggested. AUTHOR.

1924. X-Rays as a Branch of Optics. A. H. Compton. *J.O.S.A. and R.S.I.* 16. *pp.* 71–87, *Feb.*, 1928.

The paper indicates how in recent years all the familiar laws of optics have been shown to be applicable in the case of X-rays, with the special provisions required for very short wave-lengths. A study of the refraction and specular reflection of X-rays has given an important confirmation of the electron theory of dispersion, and has made it possible to estimate accurately the number of electrons in the atom. The diffraction of X-rays has yielded information of enormous value in connection with the study of crystal structure and has greatly extended our knowledge of spectra. When X-rays were diffracted by ruled gratings it made possible the study of the complete spectrum from the longest to the shortest waves. In the diffuse scattering of radiation a gradual change has been found from the scattering of waves to the scattering of corpuscles. Certain changes in or extensions to the laws of optics, rendered necessary by the study of X-rays, have been largely responsible for the recent revision of our ideas regarding the nature of the atom and of radiation. A. B. W.

1925. Reflection of X-Rays by Plane Surfaces. H. E. Stauss. *Phys. Rev.* 31. *pp.* 491–496, *April*, 1928.

The reflection of the $K\alpha_1$ radiation of molybdenum by plane surfaces of glass and quartz and by sputtered films of nickel, platinum and silver has been investigated. It was found that the critical angle of reflection of nickel was smaller for transparent than for opaque films. The critical angles for both nickel and platinum were lower than the values calculated from the electron theory. The experimental value for the critical angle of silver agreed with the theoretical within the limits of error of the experiment. Doan [see Abstract 3131 (1927)] found experimental values of the critical angle for films of a number of metals that agree with those predicted by the theory, and Edwards [see Abstract 3132 (1927)] obtained similar results using solid reflectors. If it is to be granted that the theory does hold true in the case of nickel and platinum too, it is necessary to assume that the densities of sputtered films of nickel and platinum are less than those of the metals. Further, it must be assumed that in the case of nickel the density varies with the thickness of the film, being smaller for the thinner films. The observed critical angle for quartz was smaller than the theoretical value, as though the surface density were less than the average density. Both glass and quartz surfaces showed a weak residual reflection beyond the critical angles of a type that was not present in the sputtered films. The phenomenon may be caused by irregular densities over the surface, due possibly to the polishing or to the heterogeneous composition of the two substances. AUTHOR.

1926. Polarisation of X-Rays. E. Wagner and P. Ott. *Ann. d. Physik*, 85. 4. *pp.* 425–469, *Feb.* 21, 1928.

The intense reflection of a wave-length range $\Delta\lambda$ from 0·055 Å.U. to 2 Å.U. in the continuous X-ray spectrum at a glancing angle of 45° from the surface of NaCl makes it possible to determine the polarisation gradient. This is defined as the ratio of the intensity of reflection normal to the kathode rays to the intensity of reflection parallel to the kathode rays. The polarisation gradient (pol.-grad.) increases with diminishing tube voltage. The potential gradient for the elements Pt, Ag, Cu and Fe as antikathodes has the same value, 1·4 (± 0·2), for a voltage of 10·88 kV on the tube. A. B. W.

1927. Polarisation of Kα-Radiation from Iron. H. Haas. *Ann. d. Physik*, 85. 4. *pp.* 470–482, *Feb.* 21, 1928.

An investigation is described which deals with the polarisation of the Kα radiation emitted from an iron antikathode. Within the range 12·6 to 7·4 kV the radiation is unpolarised. A. B. W.

1928. Absorption of Carbon K-Radiation in C, N and O. H. Kurtz. *Ann. d. Physik*, 85. 5. *pp.* 529–551, *March* 19, 1928.

The absorption coefficients of air, oxygen, nitrogen, carbon dioxide, carbon monoxide and ethane for the carbon K-radiation have been determined; hence the atomic absorption coefficients for O, W and C have been deduced, assuming the validity of a simple additive law for the atoms comprising the molecule. This law appears to hold for these very soft radiations, and no inference of chemical combination on the absorption has been proved. The absorption coefficient changes with atomic number according to a rule expressed by $a_{At} = \text{const. } Z^{4\cdot 4 \pm 0\cdot 4}$, the value of the constant being $(1\cdot 7 \pm 0\cdot 2)\cdot 10^{-23}$. W. V. M.

1929. K-Series of Elements Chromium to Nickel. S. Eriksson. *Zeits. f. Phys.* 48. 5–6. *pp.* 360–369, 1928.

The tube spectrometer of Siegbahn and Larsson [see Abstract 2547

(1927)] was used in conjunction with a calcspar crystal. The α_2, α_1, β', β_1 and β_2 lines of Cr, Mn, Fe, Co and Ni were measured in the first order and the lines α_2 and α_1 of Co and Ni in the second order. When the $\Delta\lambda$ values of the Kα doublet are plotted against atomic number, the curve shows a small hump for these particular elements. The accuracy of the results is discussed. F. S.

1930. Certain Multiplets in the Spectra of CbIII and CbIV. R. C. Gibbs and H. E. White. *Phys. Rev.* 31. *pp.* 520–526, *April*, 1928.

Relative positions of certain multiplets in two and three-electron systems of the second long period with wave-lengths for ZrIII, CbIV and CbIII.—Applying the irregular doublet law to the data already known for the triad of multiplets ^{3}DF, ^{3}DD′ and ^{3}DP (*ds-dp*) in the two-electron systems of SrI and YtII, the corresponding multiplets for ZrIII and CbIV have been identified. Similarly the triad of multiplets ^{4}F′D′, ^{4}F′F and ^{4}F′G′ (d^2s-d^2p) in the three-electron systems of YtI and ZrII has been extended to CbIII and the stronger lines of the ^{4}F′G′ multiplet of MoIV. In passing successively from element to element in both of these isoelectronic systems the shift in the frequency of the radiated lines for each of these multiplets is approximately constant. [See also Abstract 2544 (1927).] AUTHORS.

1931. Internal Strains in X-Ray Spectrograms. K. Becker. *Zeits. f. Phys.* 47. 5–6. *pp.* 454–456, 1928.

A reply to an attack by Göler and Sachs [see Abstract 2210 (1927)] on the author's previous paper [see Abstract 2299 (1927)]. The author claims that there is no conflict between his conclusions that the non-resolution of the Kα doublet is due to grating deformation through strains in drawn tungsten and the conclusions of Arkel [*Physica*, 5. p. 208, 1925] and Goucher [see Abstract 2252 (1926)]. The results of Göler and Sachs, properly considered, merely confirm the conclusions of the author. J. E.

RADIOACTIVITY.

1932. Transformation of Matter. E. Rutherford. *Engineering*, 125. *pp.* 315–316, *March* 16; 360, *March* 23, *and p.* 387, *March* 30, 1928. *Lectures delivered before the Roy. Inst.*

Traces back the idea of the possibility of the transmutation of one metal into another to the Alexandrian Greeks, early in the Christian era, and calls attention to the historical researches of Walden, who concludes that, while all the alchemists believed in the theoretical possibility of transmutation, the honest scientific thinkers amongst them regarded it as impracticable, and that the search for the philosopher's stone played a much smaller part in the development of chemistry than has been supposed. Notices the modern experiments in which it has been supposed that mercury has been transmuted into gold, or lead into mercury, and points out that if such transformations were practicable it would follow that the cosmos would go through a complete cycle in a few hundred years, with a very penetrating radiation of which there is no reliable evidence. The remainder of the three lectures was devoted to an account of some of the main facts of radioactivity, treated in an interesting manner from the historical point of view. Reproductions are given of several original photographs, including that which led Becquerel to the discovery of the radioactivity of uranium. H. N. A.

1933. Heating Effects of Thorium and Radium Products. S. W. Watson and M. C. Henderson. *Roy. Soc., Proc.* 118. *pp.* 318–334, *March* 1, 1928.

The rates of heat evolution by five combinations of radioactive bodies —*viz.*, Rn + Ra(A + B + C), Ra(B + C), RaC, Th(B + C), ThC—have been measured by a resistance thermometer method. The results obtained agree within 2 % with the theoretical values based on Hess and Lawson's data for the rate of emission of α-rays from radium ($3{\cdot}72 \times 10^{10}$ per gramme per second). If there is any evolution of heat other than that produced by known radiations (as is required by Geiger and Werner's value for the rate of emission of α-particles) it must be in nearly the same proportion in a large number of radioactive products, and must occur in an easily absorbed form in a quantity corresponding, if electromagnetic, to a large number of quanta per atom disintegrating. A. B. W.

1934. Phenomena in Metals Similar to those of Radioactive Bodies. (Miss) S. Maracineanu. *Comptes Rendus,* 186. *pp.* 746–748, *March* 19, 1928.

Continues the observations on old metallic roofs of the Paris Observatory described in previous papers [see Abstract 2557 (1927)]. Discs of different metals were cut from these roofs in June, 1927, and examined; the examination was repeated in October, and continued at intervals until March, 1928. The radioactivity originally observed continued throughout the whole period, without any very rapid fall. The period seems to be of the same order as that of polonium. Some suggestions are made as to the nature of this radioactivity. H. N. A.

1935. Protoactinium as Radioactive and as Chemical Element. O. Hahn. *Preuss. Akad. Wiss., Berlin, Ber.* 33. *pp.* 275–283, 1927.

A paper dealing with the estimation of the half-value period and atomic weight of protoactinium. The half-value period obtained by the author is 20,000 years (± 10 %). Taking the half-value period of UrI to be $4{\cdot}5 \times 10^9$ years, this value for protoactinium leads to 230 as its atomic weight. Russell (*Nature,* 120. p. 402, Sept. 17, 1927) gives 233, obtained from Aston's isotopic data. Fournier [Abstract 2083 (1927)] considers 231 as the most probable value—in good agreement with the author's deductions. A. B. W.

1936. β-Radiation of Protoactinium. O. Hahn and A. v. Grosse. *Zeits. f. Phys.* 48. 1–2. *pp.* 1–10, 1928.

Highly concentrated sources of Pa, prepared by methods developed by Grosse, exhibit well-marked β-ray activity, which cannot be attributed to the presence of radioactive impurities. The attribution of the β-radiation to protoactinium is supported by evidence that (1) preparations purified in different ways show sensibly the same ratio of β-ray to α-ray activity, and (2) absorption curves in aluminium for freshly prepared sources of Pa are accurately exponential, with $\mu = 126$ cm.$^{-1}$ (measured from $0{\cdot}04$–$0{\cdot}22$ mm. Al). Preparations over three weeks old show marked deviations, increasing with the age of the preparation, from the exponential form of the absorption curve. The deviations are in the sense required by the regular growth of products with more penetrating β-radiations. Comparison curves are given for radioactinium preparations of different ages. The ratio of β-ray to α-ray activity of Pa is estimated at $5 \cdot 7 \times 10^{-4}$, as compared with $15 \cdot 4 \times 10^{-4}$ for RdAc and 130×10^{-4} for the active deposit (AcC + C″). This is held to prove the secondary origin of the β-rays. Using a very strong Pa source, the absorption curves in aluminium have been followed to 0·82 mm. of aluminium and evidence obtained of the expected secondary γ-radiation. This γ-radiation is appreciably more penetrating than the β-radiations of the active deposit of actinium. H. R. R.

1937. Coefficient of Absorption in Lead of the γ-Rays from Thorium C″ and Radium C. L. Bastings. *Phil. Mag.* 5. *pp.* 785–793, *April*, 1928.

A lead absorber was employed the thickness of which was determined accurately; this was placed in immediate contact with the outside of the ionisation chamber when in use. The position of the source was fixed and filters of lead of different thicknesses were placed between it and the absorber. The coefficient of absorption in the standard absorber was measured when the rays were filtered through 2·4, 5·8 and 9·2 cm. of lead. The three values obtained for the rays from ThC″ were 0·417, 0·419 and 0·425; with RaC the absorbability of the γ-rays in lead did not increase with increasing thickness of the preliminary filter, as in the case of ThC″, but, on the contrary, diminished. The author considers this difference in behaviour in view of the differences in the constitution and intensity of the components of the γ-rays in the two elements, and shows that the observed facts are in general agreement with what is to be expected from Compton's theory of scattering. The method of Ellis and Wooster for estimating the relative intensities of the γ-ray groups of RaC has been applied to the case of ThC″, and it has been found that 88·4 % of the total energy is contained in the line $\lambda = 4 \cdot 7$ X.U., so that this substance acts almost as a monochromatic source of γ-radiation. H. N. A.

1938. Solution of the Wave Equation for the Scattering of Particles by a Coulombian Centre of Force. N. F. Mott. *Roy. Soc., Proc.* 118. *pp.* 542–549, *April* 2, 1928.

The problem has been treated by Wentzel [see Abstract 1495 (1927)] and by Oppenheimer [see Abstract 2561 (1927)]; they employ Born's method of successive approximations, and show that if $ZZ'E^2/hv$ is small the quantum theory gives the Rutherford formula. If this constant is large the quantum theory result tends towards the classical. The present paper shows that the two theories agree for intermediate values of the constant. A solution of the wave equation is obtained, which splits up into an incident wave, representing the oncoming electrons, and a scattered wave, and the quantum theory result agrees exactly with that of the classical theory. The analysis is applicable both to α- and β-particles. H. N. A.

HEAT.

1939. Thermal Conductivities of Oxygen and Nitrogen. H. Gregory and S. Marshall. *Roy. Soc., Proc.* 118. *pp.* 594–607, *April* 2, 1928.

The apparatus and method of experiment employed are the same as those previously used by the authors [see Abstract 1785 (1927)]. Lengths of fine platinum wire are stretched along the axes of two main tubes of different diameters and their compensators, and measurements made of the current C and resistance R of length l required to maintain an excess of temperature θ over that of the enclosure. If r_1 is the radius of the wire and r_2 that of the enclosure, then the thermal conductivity K is given by the equation $C^2R/l = 2\pi K\theta/(\log_e r_2/r_1) + \psi + \phi$, where ψ and ϕ are the heats lost by radiation and convection. Results are obtained at various temperatures up to 13° C. and K plotted against the temperature. The intercept of the best straight line through these points with the conductivity axis gives the absolute thermal conductivity at 0° C. The values obtained are $5{\cdot}89 \times 10^{-5}$ cal. cm.$^{-1}$ sec.$^{-1}$ deg.$^{-1}$ for oxygen and $5{\cdot}80 \times 10^{-5}$ for nitrogen. These values are not corrected for discontinuity of temperature at the boundaries of the gas, this being beyond the experimental accuracy of the experiments. The value obtained previously by Gregory and Archer for air was $5{\cdot}83 \times 10^{-5}$. T. B.

1940. Specific Heat of Hydrogen at Low Temperatures from the Velocity of Sound, and a Precision Method of Measuring the Frequency of an Oscillating Circuit. R. E. Cornish and E. D. Eastman. *Am. Chem. Soc., J.* 50. *pp.* 627–652, *March*, 1928.

The method of measuring the specific heat was that in which the velocity of sound is determined by means of closed resonators [see Abstracts 828 (1908) and 493 (1921)]. These consisted of long brass tubes closed by brass plates pierced with small central holes. Hydrogen was obtained from a 500-ampere electrolytic generator, and the sound was produced by exciting a telephone by radio apparatus consisting of oscillating circuits of the Hartley type provided with amplifiers. The frequency of the circuits was measured by comparison with a siren, using a beat method. The siren disc contained eighty or twenty holes, and was mounted on a motor with a maximum speed of 50 r.p.s., and sounded by compressed air. To the motor shaft was connected a second one which, by worm and gear, rotated a second disc at 1/192 of the rate of the siren disc. The discs were smoked for the purpose of recording time-signals from a telegraph relay actuated once a second. The frequency of the siren was adjusted to be slightly above or below that of the telephone, and beats were counted for 120 seconds. At the start of the interval a spark mark was made on the high-speed disc and another mark after 120 seconds on a different circle. Spark marks were also made at seconds No. 2 and No. 122 on the slower disc. From the four marks, the number of beats, and the whole number of revolutions of the slow-moving disc in 120 seconds (5 to 25), the frequency of the telephone and the velocity of sound in the gas are calculated. The resonator and its telephone were immersed in a stirred liquid bath contained in a long Dewar tube. Theoretically it is shown that

$$\frac{C_{v_0}}{R} = \frac{T + Y}{2 \cdot 42369 \times 10^{-8} W^2 - T + X} + Z,$$

where C_{v_0} is the specific heat of the gas at constant volume at zero pressure, R is the gas constant, T the absolute temperature, W the velocity of sound, and X, Y, Z functions of T [see also Abstract 1070 (1919)]. The effect of the tube on the velocity of sound is tested, and the Kirchhoff-Helmholtz law is fully confirmed. At each temperature the velocity was determined for five or more overtones, and the corresponding calculated specific heats are given for a temperature range 80° to 373° K. The value of C_v/R varies from 3/2 R to 5/2 R, the specific heat-temperature graph between these values resembling a magnetisation curve. The energy difference between the first two rotational states of the hydrogen molecule is 1060 calories per mole, and the relative probabilities of the two states are 1 : 1·69. The velocity of sound in free hydrogen at 0° C. is 1260·9 m./s., and that in dry air at 24° C. is 345·66 m./s. G. E. A.

1941. Latent Heat of Vaporisation as a Function of Temperature. R. M. Winter. *J. Phys. Chem.* **32.** *pp.* **576–582,** *April,* **1928.**

The latent heat of liquids can be expressed as a function of the temperature $\lambda = \lambda_0(1 - Tr)^{2/5}$, where Tr is the reduced temperature. The published data were examined to find how far the results calculated from this formula agreed with the experimental results. On the whole a very high degree of agreement was found over a considerable range of temperature. F. J. B.

1942. Boiling Point of Naphthalene. Marion Eppley. *Frank. Inst., J.* **205.** *pp.* **383–394,** *March,* **1928.**

Naphthalene is used as a medium in thermometry for the fixation of a point on the temperature scale by means of its boiling point. It is essential that the rate of variation of its boiling point with pressure should be accurately known. The present paper opens with a comprehensive survey of previous work on the subject, and finally a formula is derived by which a number of boiling points of Bureau of Standards naphthalene between 824 and 704 mm. of mercury pressure are calculated with a maximum deviation of 0·013 and an average deviation of 0·004 from the values obtained experimentally. The mean value of the boiling point of naphthalene when the pressure is about 760 mm. of mercury, determined from three Pt resistance thermometers and calculated to normal pressure by the formulæ of Holborn and Henning, Finck and Wilhelm, and the author's logarithmic formula is found to be 217·97. This is in good agreement with previously found experimental values and also with that given from the logarithmic formula put forward by the author in the present paper. Full tables of results are given. S. G. B.

1943. Thermal Measurements of Metallurgical Reactions in a Calorimeter for Working at Higher Temperatures. W. A. Roth and P. Chall. *Zeits. f. Elektrochem.* **34.** *pp.* **185–199,** *April,* **1928.**

Reactions which occur rapidly at ordinary temperatures can be measured calorimetrically with considerable accuracy, but those which occur at higher temperatures are more difficult to follow in the usual calorimeters. It was found that at a temperature of 50° C. many reactions took place rapidly between a number of substances and 2*N* . HCl. A calorimeter was designed and constructed in which the heats of reaction between 2*N* . HCl and zinc, calcium carbonate, oxide and hydroxide. The calorimeter was adapted so as to work with hydrofluoric acid, and the heat of solution of silicic acid and of different preparations of silica was determined. The apparatus was shown to be capable of a very high degree of accuracy. F. J. B.

1944. Sama Condition. E. A. Holm. *Ark. f. Mat. Astron. och Fysik, Stockholm, 20a. No.* 1. [88 *pp.*], 1927.

Results are given of experimental investigations on the Sama condition of air and carbon dioxide at room-temperature and at the pressure $2 \cdot 10^{-4}$ to $15 \cdot 10^{-4}$ mm., an unknown vapour with the pressure $6 \cdot 10^{-4}$ mm. or less being present also. Hydrogen being used as comparison gas or zero-point gas, the so-called gravimolecular pressure existing in the gases in consequence of the Sama condition has been measured directly and the corresponding temperature gradient of the gases in this state estimated. It is shown to be highly improbable that the results obtained, which are described at length, are explainable by a mere thermomolecular pressure action in the containing tubes. T. H. P.

1945. Fluctuation Phenomena According to the New Quantum Statistics. R. Fürth. *Zeits. f. Phys.* 48. 5–6. *pp.* 323–339, 1928.

In the first method of attack, a system is considered consisting of S/3 similar sub-systems between which there are no "classical interactions" (*i.e.*, molecular forces), so that the case is a generalisation of the ideal gas, although there may be "statistical coupling," which, for the different statistics, classical and quantum, results in characteristic degeneration at low temperatures. The state of the system is defined by n_i as a function of i, where n_i is the number of sub-systems in the i-th cell of magnitude h^s, of the 2S-dimensional phase-space. The "fluctuation" $\overline{\delta_i^2}$ of n_i is defined as $\frac{\overline{n_i^2} - \overline{n_i}^2}{\overline{n_i}^2}$ and is shown to be given on the classical, Bose-Einstein and Fermi-Dirac statistics by the expressions $\frac{1}{\overline{n_i}}$, $\frac{1}{\overline{n_i}} + 1$ and $\frac{1}{\overline{n_i}} - 1$ respectively. Expressions are developed for the fluctuation of density and energy in a small volume v. The energy fluctuations arise in two ways; (1) by change in the total number of sub-systems in v, and (2) by redistribution of the sub-systems among the cells of the phase space. The former are indentical with the density fluctuations and the later (isopyknic energy fluctuations) are evaluated directly. For the case of weak degeneration, a different method is employed to obtain the density, energy, pressure and temperature fluctuations on the different theories, use being made of the Boltzmann-Einstein formula for the phase probability in temperature equilibrium. Finally, a discussion is given of the possibility of using measurements of the fluctuations in a gas, at temperatures near T = 0, to decide whether it is degenerate or not, and, if so, whether in accordance with Bose-Einstein or Fermi-Dirac. The experimental difficulties of employing Smoluchowski's opalescence method for this purpose should not be insuperable. W. S. S.

SOUND.

1946. Strobokinematography of Artificial Larynges and of the Lips of the Mouth. G. Panconcelli-Calzia. *Ann. d. Physik,* **85. 4.** *pp.* **483–493,** *Feb.* **21, 1928.**

A series of films has been prepared which presents, in a systematic manner, the principles of phonetic stroboscopy, and illustrates the motions of three forms of artificial larynx and of the lips. The paper describes the films, and is of interest to phoneticians, throat specialists, physiologists and physicists. The first group of pictures displays a tuning fork and a stroboscopic disc. The text, " consecutive phases of a vibrating body seen through holes in the circumference of a rotating disc," intimates to the spectator that, with rapid rotation of the disc, an impression of continuous vibratory motion is produced. A hammer strikes the fork, the disc rotates, and the progressive motion of the prongs is plainly visible. The second group deals with the changes observed when the relative speed of the disc is varied; the optical illusion of motion is best attained when the number of stroboscopic pictures seen per second is one less than the frequency of the vibrating body. A third group deals with the best conditions of use of the stroboscope for the purposes of laryngoscopy. The principles of the author's method are illustrated, the different parts of the apparatus being shown in turn. In the second section the first group of pictures gives details of the technique of stroboscopic observation and kinematography. The stroboscopic disc employed was 40 cm. in diameter and had twelve slots each 3·5 cm. wide. The disc was driven by motor and its speed could be regulated to give from 60 to 600 exposures per second. The next group illustrates the modes of vibration of large-size larynges after the models of Müller (1837), Helmholtz (1863) and Wethlo (1913); the last of these resembles most nearly the human larynx. Observations of the vibrations of the lips were also made. G. E. A.

1947. Acoustics of Auditoriums. F. R. Watson. *Science,* **67.** *pp.* **335–338,** *March* **30, 1928.** *Address given at the Physics Colloquium, Univ. of Illinois, March,* **1928.**

Good acoustics in an auditorium may be obtained by following the design of the outdoor theatre of the Greeks. To prevent blurring of sounds by reflection, the reflecting surfaces should be near the speaker, so that two identical sounds may reach any auditor within 0·05 second (Petzold, 1927). Data relating to outdoor theatres in America support the view that elimination of the reflected waves diminishes the blurring while not diminishing to a detrimental degree the loudness of the sound. Musicians prefer a reverberant space to play in, but auditors find " dead " surroundings preferable for listening. Conditions must be favourable for the proper establishment of the sound wave, which is completed in one- or two-tenths of a second, and for the relative adjustment of the growth and decay of the sound. The masking of one tone by another is greatest when the tones are nearly alike, and loud tones mask tones of high frequency more easily than they mask those of low frequency [see Abstract 1858 (1924)]. The writer suggests that the indoor theatre should be made to conform acoustically to the outdoor theatre. [See Abstract 1335 (1928).] G. E. A.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

1948. Momentum of Conducting Electrons. A. E. Malinowski. *Zeits. f. Phys.* 47. 11–12. *pp.* 859–885, 1928.

An historical account is given of attempts made to show directly that the electric current in a conductor possesses momentum. Of these only the recent experiment of Tolman enables an upper limit to the electric inertia to be determined. The rest of the paper is concerned with the detailed account of the author's new experiment, already outlined in a previous paper [see Abstract 2345 (1927)]. W. S. S.

1949. Researches on the Problem of Quantum Electrics. G. Mie. *Ann. d. Physik,* 85. 6. *pp.* 711–729, *April* 17, 1928.

The derivation of the wave equation for a mechanical system depends upon the Hamiltonian partial differential equation. The author attempts to apply an analogous method in the case of an electromagnetic field. The current density vector, the charge density, the electric displacement vector and the magnetic induction vector, at a given point of the field, correspond to the position and velocity of a particle in the mechanical system. The vector and scalar potentials and the electric and magnetic forces, on the other hand, correspond to the particle momentum and applied force. The Hamiltonian of a mechanical system of particles is a function of the coordinates and the momenta, the partial derivatives of which determine the velocities and forces (the Hamiltonian equations). In the same way a Hamiltonian for the electromagnetic field at a point can be obtained, which is a function of the charge density and electric displacement and of the vector potential and magnetic force, the partial derivatives of which determine the remaining electromagnetic magnitudes (the electromagnetic equations). The appropriate Hamiltonian for an extended region of the field is obtained by integrating the " point Hamiltonian." The " differentiation " of this generalised Hamiltonian presents certain problems which are dealt with in detail. Finally, a Hamiltonian partial differential equation for the electromagnetic field is arrived at, and by a precisely similar step to Schrödinger's replacement of $\frac{\partial W}{\partial q}$ by the operator $\frac{h}{2\pi i}\frac{\partial}{\partial q}$, a differential equation for the " probability amplitude " ψ is obtained. If the deviation from classical electromagnetic theory is negligible except in the immediate neighbourhood of the " corpuscle " giving rise to the field, then the ψ equation reduces to Schrödinger's wave equation for a single particle. The possibility of generalising the reasoning to include gravitational fields is indicated in a final section.
W. S. S.

1950. Electromotive Forces in the Dynamical Theory of Electromagnetism. Giorgina Madia. *R.G.E.* 23. *pp.* 765–768, *May* 5, 1928.

Maxwell's derivation of the law of electromagnetic induction by applying the Lagrangian method to a system of circuits, treated as forming a dynamical system, is replaced by a simpler argument based solely on the principle of the conservation of energy without intervention of Lagrange's equations. In this way any hypothesis as to the character, kinetic or potential, of the energy of the system is evaded. The case when the circuits may have iron cores is also included in the present deduction; for this case Maxwell's treatment is invalid. W. S. S.

1951. Thermal Gradient in a Dielectric and Frictional Electricity. V. Polara. *N. Cimento,* 5. *pp.* 26–38, *Jan.,* 1928.

Investigation was made on the influence of a gradient of temperature within the mass of a dielectric on the phenomena of frictional electricity in mercury, such a gradient provoking deformations on the solid surface of the dielectric analogous to those produced by rubbing with dry cloth, but much more pronounced. From the observations made it would appear that the existence of a thermal gradient in the dielectric renders it particularly sensitive at the contact with mercury, and that according to the distribution of the temperature in the mass of the insulator the mercury with an old surface (mercury left exposed to the air for many hours) is able at the contact to take a positive or negative charge. These investigations follow up those made by Perucca [see Abstract 1586 (1921)], who showed that mercury on contact with glass and with other dielectrics became charged positively if the surface of the Hg was fresh (mercury repeatedly filtered and shaken) and negatively if the surface was old. Shaw's view that the excitability of glass depends on a particular state of its solid surface is referred to, and the author emphasises the fact that in all cases there is clearly a sensible influence of the state of the solid surface of the dielectric modified by non-uniform heating of its mass in the phenomena of frictional electricity of mercury. Further experiments are being carried out. J. J. S.

1952. Rolling of Mercury on Glass in Vacuum. Electrical and Luminous Phenomena. M. Duffieux. *J. de Physique et le Radium,* 9. *pp.* 61–70, *Feb.,* 1928.

The phenomena are produced by rotating a globe of pyrex glass containing a large drop of mercury. The bulb can be heated either directly with a Bunsen burner or by plunging its lower half into a suitable bath. The luminosity at temperatures less than 50° C. is unstable and varies in a complicated fashion. Above this temperature a steady distribution of light in the bulb is obtained, photographs being reproduced in the paper. When the glass of the bulb exceeds about 250° C. the luminosity disappears abruptly. The mechanism of the electrification of the glass at the contact with the mercury is deduced from the experimental results. W. S. S.

1953. Penetrating Radiation. J. Clay. *K. Akad. Amsterdam, Proc.* 30. 9–10. *pp.* 1115–1127, 1927.

Observations were made with two Kolhörster instruments in Java, at 760 and 3024 metres above sea level, and up to 4300 metres in an aeroplane; also in the Red Sea, Suez Canal and Mediterranean, in the laboratory of V. Hess at Graz and in a salt mine at Strassfürt. The Java observations at 760 metres were made in the months of February–July 1927. There was a diurnal variation of the penetrating radiation, with a minimum at about 8 a.m. There was no sign of any effect due to the sidereal time, so that, if the observed change is actually due to radiation from above, it must be generated in the higher regions of the atmosphere. The curves are compared with those obtained at the same station for the number of ions in the atmosphere and its potential gradient; the first shows a strong minimum at about 730 a.m. and the second a maximum at about 8 a.m. Measurements of the absorption in different thicknesses of lead indicated two kinds of rays, $\lambda_1 = 3 \times U$ and $\lambda_2 = 0{\cdot}8 \times U$. The observations seemed to indicate the existence of a secondary radiation proceeding upwards from the earth. The value of the radiation increased on the voyage up the Red Sea and into the Mediterranean. It was thought that in the salt mine there would be no radiation, but this did not prove to be the case. H. N. A.

1954. Observations of Penetrating Radiation during the Solar Eclipse of June 29, 1927, in Berlin. W. Kolhörster. *Zeits. f. Phys.* 48. 1–2. *pp.* 95–97, 1928.

Observations were made during the eclipse with three ionisation chambers, one on the roof and the others in a top room immediately below the first. The outside instrument was read at intervals of one minute, while the others recorded photographically. Temperature and humidity observations were obtained with an Assmann psychrometer. The results show no direct influence of the solar eclipse on the total ionisation inside a closed thick-walled vessel within the limits of error of the measurements. R. S. R.

1955. Electric Potential Gradient Measurements at Eskdalemuir, 1913–1923. R. A. Watson. *Meteorolog. Office, Geophys. Mem.* 4. *No.* 38. [16 *pp.*], 1928.

Measurements were obtained by means of a Kelvin water dropper connected to a Dolezalek electrometer, the deflections of the needle being recorded photographically. The hourly measurements of potential gradient on quiet days (O*a*), *i.e.*, the potential not negative at any time in the day and no hour with a range above 1000 volts/metre, were analysed harmonically and the indications of 6-, 8-, 12- and 24-hour terms are described. The potential gradient depends largely on wind speed, mainly because of the different amounts of turbulence set up. The changes may be explained by assuming that the earth gives a potential gradient of 100–150 volts/metre, and local atmospheric charges, which increase in the absence of wind and other mixing agents, cause the remainder of the observed potential gradient. Cloud amounts have little effect, but temperature has some, especially where air masses of different origin arise. The author concludes that the annual and diurnal variations of potential gradient are controlled by two factors depending on universal time and one depending on local time. Over the land the latter in general masks the former and differs from place to place. Over the sea the universal time factors are the important ones, and give a diurnal variation with a minimum at 4 hours and a maximum at 19 hours G.M.T. At present this variation cannot be subtracted from that observed at a land station to get the true local variation, because (1) more sea observations are required to get the magnitude of the universal time variation, and (2) the absolute value of potential gradient is difficult, and in many places perhaps impossible to determine. R. S. R.

DISCHARGE AND OSCILLATIONS.

1956. Experiments with Modified Muchronate Electrodes. C. Barus. *Nat. Acad. Sci., Proc.* 14. *pp.* 188–191, *Feb.*, 1928.

Two discs about 2 cm. in diameter were employed as electrodes, and connected to a small electrostatic machine. One of them had a hole at the centre connecting to a glass tube leading to an interferometer U-tube, for measuring the pressure, s, of the electric wind from a needle, which projected into the space between the electrodes at the centre of the other disc. The length, y, of this could be adjusted by a screw micrometer. The relation between s and y was plotted for different conditions of the apparatus. In some experiments the electrode with the needle was used as anode, in others as kathode. The curves were not greatly altered by wetting the electrodes with glycerine; s increased at first to a maximum when y increased, and then dropped to much smaller values. With the dimensions and voltage employed the critical value of y was 0·06 cm. when the electrode with the projecting point was the kathode, and 0·24 cm. when it was the anode. The maximum pressure of the positively ionised wind was about the same as for that from the kathode. H. N. A.

1957. Telescopic Observations on Kathode and Anode Points. C. Barus. *Science*, 67. *pp.* 248–249, *March* 2, 1928.

Describes observations on the kathode point of the muchronate electrodes used in another investigation [see preceding Abstract]. The needle is critically set so that the convection current is just about to pass into the spark condition. This passage is brought about by bringing a negatively charged body, such as a charged ebonite rod, into certain positions with regard to the gap. In some cases diffuse bright purple spark filaments appear, accompanied by a marked crackling in a suitable ear trumpet; in other cases ("dark sparks") there are no visible spark lines, but only a faint violet surface glow at the edges of the anode plate; there is no appreciable crackling in the ear trumpet. The U-tube interferometer was not employed in this investigation. The anode reactions have also been observed telescopically. Snapping white sparks appear when there is an anode point but no kathode point; these sparks may degenerate into a purplish diffuse cone. H. N. A.

1958. Glow Discharge. M. Büge. *Arch. f. Elektrot.* 19. *pp.* 480–485, *March* 15, 1928.

An experimental investigation was made of the time lag (t) between the application of voltage to the discharge tube and the commencement of the glow discharge; also of the interval (T) necessary between two successive discharges for them to be independent of one another. Curves are given expressing t as a function of T, and it is shown how these curves alter under different conditions of preliminary ionisation and with variation of the applied voltage. A. W.

1959. Corona Discharge in Helium and Neon. L. G. H. Huxley. *Phil. Mag.* 5. *pp.* 721–737, *April*, 1928.

The author has investigated the corona discharge in carefully purified helium and neon with the object of determining the velocities of the positive ions and their effects in ionising the gas. A nickel wire, 1·65 mm. or 2 mm. diameter, is stretched in the middle of a nickel cylinder in three sections, the two outer acting as a guard ring. Measurements are made of the potentials required to start or maintain a current between the wire and the cylinder. Curves are given in illustration of the main results. It is shown that the discharges cannot be explained on the hypothesis that the current is maintained by the ionisation of the molecules of the gas by electrons combined with the liberation of electrons from the negative electrode by the action of positive ions (extension of Townsend's continuity theorem). The results further indicate that the molecules of helium and neon show, towards positive ions of certain velocities, large reductions in the effective diameter, and that the mean free paths in neon are about five times the mean free paths in helium. T. B.

1960. Low-Voltage Arcs in Iodine. H. F. Fruth. *Phys. Rev.* 31. *pp.* 614–628, *April*, 1928.

Low-voltage arcs in monatomic and molecular iodine vapour have been investigated together with their spectra. From the current-voltage curves it follows that 6·5 volts is the minimum radiating potential of the atom, 8·0 its ionising potential, and 9·5 that of the molecule. With arc currents of about 2 amps. the filament current could be cut off and the arc sustained indefinitely at 30 volts or above. At 4·9 volts the spectrum contained only three lines (λλ2062, 2535, 3135), the continuous band 3460, and several groups of bands. At 8 volts the strongest spark lines begin and indicate that the stripping of the atom is in progress. Three continuous bands (at 4080, 4300 and 4800 Å.) are present in molecular but disappear in atomic iodine. H. H. Ho.

1961. Electrical Properties of Monatomic Gases. J. S. Townsend and S. P. MacCallum. *Phil. Mag.* 5. *pp.* 695–700, *April*, 1928.

Under the action of the electrodeless discharge impurities rapidly disappeared, a fact that was verified both by the spectra and by the constancy of the sparking potentials. W. G. B.

1962. Smallest Electricity-Carriers in Gases. L. B. Loeb. *Ann. d. Physik*, 84. 5. *pp.* 689–696, *Nov.* 19, 1927.

The electrostatic attractive forces between a gaseous ion and neutral molecules may apparently increase the ionic radius either by a bending together of the paths of the molecules and an accompanying shortening of the free paths, or by true joining of the molecules with formation of a cluster ion. When treated theoretically, both cases lead to agreement with the ionic mobilities observed experimentally in order and in order of magnitude. Hence measurements of mobility in pure gases do not allow any conclusion to be drawn. In case a cluster ion is formed, it may, on account of the slight difference of energy between its potential energy and the kinetic energy of the heat movement, have only a more or less static diameter. Theoretically, dielectric constants, as measured normally, cannot be used for the treatment of mobilities, since the polarisation in non-homogeneous ionic fields does not correspond with that in homogeneous macroscopic fields. This is shown most clearly by the differing mobilities of positive and negative ions, with which the molecular structure comes into play. In gases like hydrogen chloride, water, hydrogen sulphide, alcohol, etc., the presence of a proton near the surface of the molecule depresses the negative mobilities below those of the positive ions. Erikson's results [see Abstract 1728 (1915)] and those of the author show clearly a selective accumulation at positive or negative ions which is to be regarded as cluster formation. As regards their magnitude, it is at present only moderately certain that the cluster ions are relatively small (less than six molecules), and it must be kept in view that under some circumstances separate ions occur and that only condensation or accumulation of the molecules in the neighbourhood of the ions take place. T. H. P.

1963. Mobilities of Gaseous Ions in H_2S-H_2 Mixtures. L. B. Loeb and L. du Sault. *Nat. Acad. Sci., Proc.* **14.** *pp.* **192–199,** *Feb.,* **1928.**

Special precautions were taken to obtain pure H_2S, since impurities greatly affect the mobility of the ions. A new form of ionisation chamber was employed. The average values obtained were 0·612 for negative ions of H_2S and 0·629 for positive ions at atmospheric pressure in pure H_2S, or reduced to the absolute scale 0·69 and 0·71 cm./sec. per volt/cm. Results at low pressures indicate that the inverse pressure law holds for negative ions, but possibly not for positive ones; this is contrary to the theory of Alexeievsky. Free electrons were observed in the gas below 50 mm., so that H_2S stands between air and O_2 in its power of attaching electrons to form ions. In mixtures of H_2S and H_2 traces of H_2S lower the mobility of the H_2 ions, indicating clustering. H. N. A.

1964. Conduction of Electricity in Flames. P. Lenard. *Ann. d. Physik,* **85. 6.** *pp.* **730–744,** *April* **17, 1928.**

Recent work by Zachmann [see Abstract 2836 (1924)] has shown that the earlier assumption that the liberation of electrons from metal atoms in the flame is almost entirely due to collisions between metallic atoms, must be replaced by attributing the free electrons to collisions between metal atoms and flame molecules. The interpretation of earlier experiments in the light of this important modification is undertaken in this paper. On the basis of Zachmann's measurements, calculations are made of the drift velocity of the electrons in the Bunsen flame, the fraction of metal atoms carrying a positive charge, the concentration of the electrons, the number of electrons set free in a single collision, and the drift velocities of the metal atoms in the flame. The observations for flames of high metal content are shown to lead to the conclusion that, owing to the larger electron concentration in such cases, the electrically neutral metal atoms give up electrons in a collision more readily than when free electrons are comparatively scarce. W. S. S.

1965. Reflection of Positive Rays by a Platinum Surface. G. E. Read. *Phys. Rev.* **31.** *pp.* **629–633,** *April,* **1928.**

Intensity, energy and directional distribution of Li^+ and K^+ ions reflected from platinum.—In studying the reflections of positive rays by a platinum surface an apparatus similar to a spectrometer was set up in a good vacuum. A beam of lithium ions accelerated through a known p.d. impinged upon a platinum reflector. The intensity, energy and direction of the reflected beam were measured by means of a rotating collector. Providing the reflector were "clean," *i.e.,* white hot or cold but a few seconds, a considerable reflection was observed at certain angles. The angle of reflection was approximately specular but varied slightly with the accelerating voltage. The percentage reflected depended markedly upon the accelerating voltage. The maximum occurred approximately at 48 volts where approximately 75 % were reflected. The reflected beam consisted of ions which had lost the major portion of their energy. Using a beam of potassium positive rays, approximately the same type of results was obtained. AUTHOR.

1966. Experiments in Positive Ion Kinetics. G. P. Harnwell. *Phys. Rev.* 31. *pp.* 634–642, *April*, 1928.

Mean free path and mean energy loss per collision of positive ions of potassium and cæsium in helium, neon, argon, hydrogen and nitrogen.—The motion of certain positive ions through gases was investigated in an experimental tube of simple design. The ions were obtained from the potassium and cæsium catalyst sources developed at the Fixed Nitrogen Laboratory, and their behaviour was studied in helium, neon, argon, hydrogen and nitrogen. It was found that the results were best explained on the basis of a free path approximately equal to the kinetic theory value, and on an average fraction of energy lost per collision considerably less than would be expected on ordinary considerations. It is suggested that the explanation of this is to be found in a more accurate consideration of the fields of force involved at these encounters. AUTHOR.

1967. Reflection of Atoms by a Crystal. A. Ellett and H. F. Olson. *Phys. Rev.* 31. *pp.* 643–647, *April*, 1928.

Directional distribution of cadmium, mercury, sodium and hydrogen atoms reflected from rock-salt.—Beams of cadmium and mercury atoms striking a clean rock-salt surface are reflected so that incident and reflected beams make equal angles with the normal to the crystal surface. The divergence of the reflected beam is only a little greater than that of the incident beam. Sodium is not reflected from a rock-salt surface. Hydrogen atoms striking a rock-salt surface leave as atomic hydrogen. The distribution of the directions in which they leave the surface has never been the same for any two crystals. This may be due to failure to remove all adsorbed gas. AUTHORS.

1968. Direction of Emission of Photoelectrons. P. Auger. *Comptes Rendus*, 186. *pp.* 758–760, *March* 19, 1928.

The author has examined by the Wilson cloud method the distribution in space of the direction of emission of photoelectrons. The confirmation of theory is fairly good, but certain deviations have been observed. It is shown that the distribution is not symmetrical, indicating a principal maximum of 80° and a secondary at 60°, with a small increase near 120°. The interpretation of these results is not yet definitely established. A. B. W.

1969. The Crystal Detector Problem. G. G. Reissaus. *Phys. Zeits.* 29. *pp.* 223–225, *April* 15, 1928.

The author investigates the question of the direction of the rectified current in a particular crystal detector combination. In contrast with other crystals, a galena crystal of clear fracture, combined with a fine copper wire, gives a constant direction of current, the wire being negative and the crystal positive, except when the wire enters a tiny fissure in the crystal, when the current may reverse. This is because the rough surface of the fissure provides a " point," the wire then becoming a " surface." For all crystal combinations, the " point " and " crystal " can exchange rôles, the electron current flowing always from the " point " to the " surface." [See also Abstract 1862 (1927).] E. T. A. R.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1970. Influence of Electric Charge on Conductivity. M. Pierucci. *Accad. Lincei, Atti,* 7. *pp.* 400–405, *March* 4, 1928.

Experiments were carried out on extremely thin pellicles of metal. The method is described and the causes of error are discussed. Generally, the resistance is increased or diminished a few ten-thousandths according to the sign of the charge, and for the most part this charge is permanent. A. D.

1971. Galvanic Conductivity and the Hall Effect of Thin Platinum Layers. A. Riede. *Zeits. f. Phys.* 48. 5–6. *pp.* 302–309, 1928.

This work extends a previous investigation on thin nickel layers [see Abstract 416 (1925)] to the case of platinum. Peacock's work is referred to [see Abstract 2183 (1926)]. The conductivity of the platinum layers produced on glass by kathode scattering in streaming hydrogen is found to be proportional to the thickness with an accuracy of 3 $m\mu$. The Hall effect of these layers is essentially constant for thicknesses down to 30 $m\mu$ and then strongly decreases with diminishing thickness. H. H. Ho.

1972. Wave Mechanics and Metallic Conductivity. J. Frenkel. *Zeits. f. Phys.* 47. 11–12. *pp.* 819–834, 1928.

Derives in an elementary manner the Fermi distribution of the velocity of the electrons at the absolute zero of temperature, compares the result with the author's previous estimate of the zero point energy, and interprets it in terms of wave mechanics as a superposition of resonance waves with the amplitude unity. An estimate of the scattering of these kathode waves (which replace the electrons in the theory) caused by the thermal movements of the atoms of the metal, which cause variations of density, leads to an expression for the electrical conductivity of metals, which agrees approximately with the experimental values. The waves have to be regarded as long. H. N. A.

1973. Apparent Non-Proportionality of Photoelectric Currents. B. Kurrelmeyer. *J.O.S.A. and R.S.I.* 16. *pp.* 92–93, *Feb.,* 1928.

The author refers to deviations of 5 % from proportionality between light intensity and photoelectric current. It was found that these deviations are due to a " feed-back " effect, that is, the potential difference of the charges accumulating on the electrometer reduced the potential difference across the cell by an amount sufficient to produce the observed lack of proportionality. A. B. W.

1974. Action of Radioactive Radiation on the Dielectric Constant. G. Guében. *Comptes Rendus,* 186. *pp.* 861–863, *March* 26, 1928.

In the grid and anode circuits of a triode valve are placed two oscillating circuits the mutual induction of which is variable; a galvanometer is connected in the grid circuit. With suitable coupling of the two inductances there is a strong deviation of the galvanometer when the capacity of the anode surface varies. The method works well, in spite of the necessity of employing a thick lead screen about the radium tube, part of the screen being movable, so that the tube can be brought into position to irradiate the dielectric under test. None of the dielectrics tested showed any measurable change in the dielectric constant. H. N. A.

1975. Dielectric Constants of Dilute Solutions of Polar Liquids in Non-Polar Solvents. J. D. Stranathan. *Phys. Rev.* 31. *pp.* 653–670, *April*, 1928.

The electric moments of methyl, ethyl, propyl and amyl alcohols have been determined at various temperatures through a study of their dilute solutions in benzene. The moments in each case come out essentially independent of temperature, in agreement with the Debye theory; it is in contrast to the behaviour of the pure liquid alcohols. The data obtained can in no case lead to imaginary electric moments, as do the data on the pure liquids; on the other hand, they point to a range of values whose extremes differ by not more than 20 %. A. D.

1976. Dielectric Constants in Benzol Toluol under Electric Waves. R. D. Schulwas-Sorokina. *Zeits. f. Phys.*, 48. 5–6. *pp.* 426–436, 1928.

A. R. Colley found with benzol-toluol mixture under damped electric oscillations, λ = 60 cm., an effect analogous to the photo effect. The author, using undamped oscillations, λ = 380 m., obtained no such analogous effect. A. D.

1977. Longitudinal Thermomagnetic Potential Difference in a Bismuth Crystal. C. W. Heaps. *Phys. Rev.* 31. *pp.* 648–652, *April*, 1928.

The longitudinal thermomagnetic potential difference in a bismuth crystal has been measured at room-temperature for various orientations of heat current, magnetic field and crystal axis. The results are plotted to show the change of thermoelectromotive force as a function of magnetic field strength. When the heat current is parallel to the crystal axis the field produces an apparent increase of thermoelectromotive force, the maximum being about 7 % in a field of 7000 gauss. When the heat current is perpendicular to the crystal axis the field produces a decrease of thermoelectromotive force, the maximum being 23 % in a field of 7000. Some of the data are in poor agreement with previous work by Lownds and Defregger. The results may be explained qualitatively by assuming that a magnetic field produces a structural change of some sort in the atomic system of bismuth. This change, in the direction normal to the field, is essentially different from the change parallel to the field. AUTHOR.

1978. Compensating Rheostats. F. C. Walz and L. R. Jackson. *J.O.S.A. and R.S.I.* 16. *pp.* 198–202, *March*, 1928.

The authors describe a method of varying in infinitesimal steps the electromotive force of a circuit, while automatically keeping the resistance of the circuit constant, when the source of the e.m.f. is a battery. The circuit consists of the battery shunted by a rheostat, from which is tapped off a variable p.d. to supply the load circuit in series with a compensating resistance; the latter consists of a cone rheostat in series with a linear rheostat, these two sliders moving in unison with that of the rheostat across the battery. E. T. A. R.

1979. Use of Negative Charges of Kathode Rays as Means of Marking in the Kathode-Ray Oscillograph. P. Selényi. *Zeits. f. Phys.* 47. 11–12. *pp.* 895–897, 1928.

In former methods the curves produced by the kathode rays were fixed either by their phosphorescence or direct action on the photographic plate in the kathode-ray oscillograph. The author used a V-shaped glowing electrode, and kathode rays were projected in the desired direction by surrounding the electrode by, and connecting it to, a metal cap. The kathode rays passed through a circular opening in a cylinder maintained at a voltage 150–300 volts above that of the kathode. The inner surface of the glass bulb was coated with Mg and this metallic film formed the anode, a pressure of 3000–4000 volts being applied. On dusting the outer surface of the bulb with powdered sulphur the usual figures are obtained. With a kathode-ray strength of 1 microampere a velocity of marking of 30 km./sec. is obtained. Further experiments in the use of this discovery are in progress. R. S. R.

1980. Supply of Alternating Current to the Quadrants of an Electrometer for Radioactive Measurements. G. Fournier. *J. de Physique et le Radium*, 9. *pp*. 71–72, *Feb*., 1928.

The use of accumulators to obtain high voltages on electrometers is an expensive process when initial cost and maintenance are considered. The author describes an apparatus consisting of (1) a transformer by which he steps up from 110 to 2000 volts with tappings at each 500 and the central point earthed; (2) two triode emitters used as diode rectifiers; (3) two condensers of 1 microfarad capacity, each having one plate earthed, and used to stabilise the voltage; and (4) two identical ionisation chambers used to eliminate the effect of stray variations of voltage. Each valve is connected to one ionisation chamber, and these acquire opposite charges and so eliminate the stray effects. The apparatus can measure satisfactorily a current of 10–13 amperes. R. S. R.

ALTERNATING CURRENTS AND MAGNETISM.

1981. Projection of Curves corresponding to Variable Currents. A. Bartorelli. *N. Cimento*, 5. *pp*. 1–8, *Jan*., 1928.

The author explains his method of projecting to a distance and on a large scale the curves which correspond to variable currents. This method depends on the ponderomotive action of a constant magnetic field upon a conducting wire traversed by a current, combined with an arrangement of stroboscopic projection. The theoretical basis of the method is stated, and the means of carrying it out experimentally is explained, as well as the precautions necessary so that it may be recognised when the frequency of the current which traverses the wire corresponds with that of the illuminations furnished by the stroboscopic disc. Hence is derived the possibility of determining the frequency of an alternating (or, at any rate, a periodic) current by means of a disc rotating with known velocity, and, on the other hand, of measuring the velocity of rotation of a disc by means of an alternating current of known frequency. In the last part of the paper a description is given of the method to be adopted in order to obtain the projection of clear curves of periodic currents by means independent of the rotation of the disc—an arrangement applicable to both monophase and polyphase currents. Reproductions of three of the curves obtained are given on a reduced scale. J. J. S.

1982. Electrical Oscillations in Compound Circuits, and the Measurement of the Capacities of Resistances and Coils by the Resonance Method. M. Jezewski. *Zeits. f. Phys.* 48. 1–2. *pp*. 123–136, 1928.

Enlarges the previous results of the investigation of an oscillation circuit with a resistance connected in parallel with the condenser [see Abstract 2615 (1927)]. The oscillations in a circuit with a self-induction coil connected in parallel with the condenser are also investigated. Formulæ are derived for voltage and current in these circuits, and the method of measurement of the capacities of resistances and self-inductions by determining the point of resonance, or, rather, two points on either side of and near to the resonance point at which the current has the same value, is described. Examples are given of measurements made in this way, in one of these values of λ ranging from 300·0 to 57·5 metres were employed; the values obtained for the capacity of a self-induction coil of 0·001 henry varied from 44·8 to 42·5 cm., which under the circumstances of the experiment is regarded as satisfactory. H. N. A.

1983. Wiedemann Effect and Applications. E. Fromy. *Soc. Franç. Élect., Bull.* 7. *pp.* 47–75, *Jan.,* 1928.

The first part of this paper consists of a *résumé* of an earlier one [see Abstract 1055 (1928)]. In the second part a resonance galvanometer is described in which the effect is applied. It is produced in an iron tube placed between the poles of an electromagnet. This is fed with the alternating current to be investigated and is wound so as to produce consequent poles in the two halves of the tube. An axial current of about 6 amperes from a battery is passed through an insulated wire. Resonance to the period of the alternating current is adjusted by means of weights on a small lever. F. S.

1984. Origin of the Magnetism due to Atomic Structure. K. Honda. *Zeits. f. Phys.* 47. 9–10. *pp.* 691–701, 1928.

The optical or satellite electrons are the cause of diamagnetism in the atom, but ferro- and paramagnetism are caused by the very fast moving electrons within the atomic nucleus. The atomic nuclei of the elements have magnetic moments which are determined by the number and velocity of the nuclear electrons. In a ferromagnetic atom, the resultant angular momentum (A.M.) is almost zero, in a paramagnetic the A.M. has a finite value, and in a diamagnetic the A.M. is so great that the substance is almost unmagnetisable. Rise of temperature has an effect similar to that of A.M. Langevin's expression for the susceptibility is modified, and it is shown that the susceptibility $K = K_p - K_d$, where K_p is the paramagnetic susceptibility and K_d the diamagnetic. Change of susceptibility with allotropic modification and with melting is then considered. When, during either of these changes, a decrease of volume takes place, the relative number of free electrons is increased, the Langevin diamagnetism becomes smaller, and the electric conductivity increases. This is confirmed by the observed changes in iron. In iron the A_3 change at 910° is accompanied by shrinkage in volume and decrease in paramagnetic susceptibility in accordance with the theory; so also with the opposite change at 1400° (A_4). In the case of thallium, which is diamagnetic, the metal has an allotropic change at 225°, diminishes in volume, in diamagnetic susceptibility and electrical resistance, as required by the theory. If the susceptibility is graphed with the atomic number, the para- and diamagnetic values lie on a continuous curve. This follows at once from the equation $K = K_p - K_d$. The fact that a paramagnetic combination may be formed from two diamagnetic atoms is thus explained: in these atoms the A.M. may be very large, but on the formation of a molecule the resultant A.M. may be very much smaller so that the molecule appears to be paramagnetic. Other observed facts receive a satisfactory explanation from the author's theory. G. E. A.

1985. Magnetic Susceptibility of Solutions. J. J. Weigle. *Phys. Rev.* 31. *pp.* 676–679, *April*, 1928.

It is shown that, when a solution of ions of different magnetic susceptibilities is placed in a magnetic field, there is a difference between the concentrations of the solute in the field and outside of the field. This difference, however, is so small that it can hardly be measured experimentally, therefore, it cannot vitiate the measurements of the magnetic susceptibility of solutions by the classical methods. AUTHOR.

1986. Dielectric Constants and Magnetic Susceptibilities in the New Quantum Mechanics. Part III. Application to Diamagnetism and Paramagnetism. J. H. van Vleck. *Phys. Rev.* 31. *pp.* 587–613, *April*, 1928.

This paper continues Parts I and II [see Abstract 2757 (1927)] and in § 1 gives the necessary modifications of the mathematical theory. The main additions are the appearance of a diamagnetic term and allowance for the fact that the magnetic moment consists of two parts arising respectively from orbital electronic motions and from the electrons' internal spins. § 2 deals with diamagnetism and shows that Pauli's formula is an upper limit to the diamagnetism in non-monatomic molecules, and a good approximation when the Schrödinger wave function has nearly as much symmetry as in an atomic S state. §3 considers the paramagnetism of atoms and finds the limiting values of the susceptibilities χ to be $\mathrm{N}[4s(s+1)+k(k+1)]\beta^2/3k\mathrm{T}$ and $[\mathrm{N}g^2j(j+1)\beta^2/3k\mathrm{T}]+\mathrm{N}\alpha$, where β is the Bohr magneton and α is a constant. These formulæ are rigorously applicable when the multiplet intervals are very small or very large compared with $k\mathrm{T}$. § 4 investigates molecules on the Hund theory, and shows that polyatomic molecules may have lower paramagnetic susceptibilities than diatomic because the dissymmetry causes large fluctuations in electronic angular momentum. § 5 gives an unambiguous calculation of the susceptibility of NO which agrees with the experimental value within 1·5 %. Abstract 216 (1927) should also be consulted. H. H. Ho.

1987. Lunar Diurnal and Solar Diurnal Magnetic Variations. J. Egedal. *Terr. Mag.* 32. *pp.* 139–141, *Sept.–Dec.*, 1927.

In a previous paper [see Abstract 1314 (1927)] the relation $\mathrm{L/S}\,.f(\phi)\cos^2\phi = C$ has been proposed. It is now shown that $f(\phi)$ should be unity for every latitude, while S should be computed as the mean of all the monthly oscillations during the period. The tables of the former paper are corrected and amplified. A. Wh.

1988. 27-Day Recurrence Interval in Magnetic Disturbance. J. M. Stagg. *Meteorolog. Office, Geophys. Mem. No.* 40. [8 *pp.*], 1927.

Character figures 0, 1 or 2 for each hour of the years 1917, 1921, 1922 and 1923 were assigned to the Kew magnetograph records for declination and horizontal force considered separately and conjointly. The results obtained showed a daily crest over the period 25 days 13 hours to 30 days 12 hours for the recurrence of character 2. The most favoured epoch for the recurrence of the disturbance maximum is approximately 27 days from the original disturbed day, but it may be 1 to 2 days different from it. It is considered that the curves may result from a combination of variations with slightly different phases and with the disturbance associated with the recurrence superimposed and thus a 26-, 27- or 28-day recurrence interval may result. Viewed physically, since the principal seat of the magnetic variations, regular and aperiodic, is considered to be some conducting layer or layers of the earth's atmosphere, alterations in the conductivity conditions there due to the superimposed effect of an apparently insignificant sunspot or a chance concentration of two or more such diminutive sunspots may be responsible for converting what might have been a 27-day into a 26- or 28-day interval for the occasions concerned. [See also Abstract 460 (1928).] R. S. R.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

1989. Radiological Study of the Bone Changes in Renal Infantilism. C. G. Teall. *Brit. J. of Radiology,* 1. *pp.* 49–58, *Feb.,* 1928. *Paper read before the Roy. Soc. of Medicine, Dec.,* 1927.

Definite changes in the radiographic appearance of the bones are found in renal infantilism, radiographs showing two distinct types of change, called by the author the "rachitic" and "woolly" types respectively. The rachitic type is practically identical with ordinary rickets, but the woolly type is characteristic and sufficiently typical to be of diagnostic value. The lesions found in this type are asymmetrical and may be much more marked in one bone than another. The marked deformities in renal infantilism are produced by a collapse of the bone in the metaphyses which throws the end of the bone out of line. W. V. M.

1990. Trend of Modern Therapeutics. A. Soiland, W. E. Costolow and O. N. Meland. *Brit. J. of Radiology,* 1. *pp.* 61–65, *Feb.,* 1928.

The historical development of medical science is briefly considered. For therapeutics physical methods, *i.e.,* the utilisation of diathermy, X-rays, radium, and phototherapy, are becoming of more and more importance. In America the American Medical Association have created a council on Physical Therapy. Some of the present-day questions such as relates to X-ray dosage, etc., are briefly discussed. B. J. L.

1991. Flesh Contours in Radiograms. A. P. Bertwistle. *Brit. J. of Radiology,* 1. *pp.* 65–67, *Feb.,* 1928.

The background of radiographs are blacked out by India ink to produce a silhouette of the fleshy contours. Advantages claimed for this procedure are described. B. J. L.

1992. Importance of Röntgenograms in the Diagnosis of Renal and Urethral Calculi. S. A. Heyerdahl. *Brit. J. of Radiology,* 1. *pp.* 75–90, *March,* 1928. *Paper read at a meeting of the Medical Soc., Oslo, Nov.,* 1924.

This paper is a general review of radiological investigations of the renal tracts in medical diagnosis. The error of diagnosis in the detection of renal calculi is now from 2 to 4 %, these small errors being due to absence of shadows when the composition of the calculi are such as to offer little absorption to X-rays. The technique of renal examinations is described and the differential diagnosis of renal calculi from other radiographic shadows is given in detail. The use of X-ray opaque catheters to localise renal stones is described and also the use of pyelography for which solutions of non-opaque salts, as sodium iodide, are injected into the renal pelves for diagnostic purposes. This paper is a useful summary of the uses of X-ray examination in renal work and is within reasonable compass. Useful radiographs are illustrated. B. J. L.

1993. Röntgen-Ray Treatment of Primary Carcinoma of the Lung. R. Paterson. *Brit. J. of Radiology,* 1. *pp.* 90–96, *March,* 1928.

The difficulties and small success of surgical methods of treating lung cancer are mentioned. The treatment by radiation methods is then discussed. No completed group of cases of this disease treated by radiation has been reported and, among the cases reported singly, there are no authentic cures. A tabular analysis of reported cases is given and a useful bibliography of the literature. B. J. L.

1994. Electrical Fields Surrounding Human Beings. F. Sauerbruch and W. O. Schumann. *Zeits. f. tech. Phys.* 9. 3. *pp.* 96–98, 1928.

For the past three years the authors have investigated the question as to whether electromagnetic effects are produced in the region of the human body by physiological processes. A five thermionic valve amplifier is described, and with this evidence of electromagnetic fields could not be demonstrated. By means of a three-valve amplifier electric fields due to muscular action were detected. The authors discuss extraneous causes to which these fields could be attributed, but find they are due to physiological causes. Curves are shown which register the electrical changes due to respiration and also due to muscular tetany produced by strychnine poisoning in the rabbit. B. J. L.

1995. Bioelectric Currents Amplified. E. Benedetti. *Accad. Lincei, Atti,* 7. *pp.* 423–427, *March* 4, 1928.

The necessary apparatus and adjustments described for amplification up to five-valve power (theoreticaly 39,000,000 times) and acoustical transformation by telephone or loud speaker, or mechanical transformation by a recording drum. Striking results are obtained. A. D.

1996. Application of Electronic Valves in Biology and Medicine. F. Scheminzky. *E.u.M.* 46. *pp.* 377–383, *April* 22, 1928.

Applications of thermionic valves are considered as regards the excitation of high-frequency oscillations for medical diathermy apparatus, for testing auditory threshold valves, for the production of an ultra-micrometer to investigate the growth of plants, to register vocal sounds and reproduce them in the form of oscillographic curves, to measure the electrical conductivity of living tissues, and to destroy neoplastic tissues of plants. The special application to the study of nerve and muscle physiological preparations, as used by the author, is then considered in detail, the apparatus being described. The Mecapion apparatus of Strauss, in which thermionic valves are used to detect and measure the intensity of X-rays by means of the ionisation induced, is also described. Further, the polarisation of muscle and nerve preparations can be measured by such valve apparatus. This paper is of importance, the connections used by various authors for various purposes being given. A fairly comprehensive bibliography enables original papers to be consulted. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

1997. Adsorption of Strong Electrolytes by Pure Ashless Carbon. I. M. Kolthoff. *Zeits. Elektrochem.* 33. *pp.* 497–500; *Disc.*, 501, *Nov.*, 1927. *Paper read before the Deut. Bunsen Gesell., Dresden, May,* 1927.

The activated carbon used was prepared by charring pure sucrose and heating the fine powder for 24 hours at 900–960°. This material adsorbs inorganic acids from their 0·1 *N* solutions in amounts diminishing in the order thiocyanic, hydriodic, nitric, iodic, hydrochloric, hydrobromic, sulphuric and phosphoric, the last showing no, and sulphuric acid very slight, adsorption. The above order is the same as that for the activity of these acids in depressing the surface tension of water. The adsorption of a strong acid by charcoal is increased by addition either of a neutral salt of the acid or of another inorganic acid. The adsorption of the strong acids is practically prevented by the presence of phenol or amyl alcohol, but these acids partially displace adsorbed acetic acid from the charcoal. The strong acids appear to be adsorbed in the non-dissociated form. The adsorption of strong inorganic bases is either non-existent or of negative sign, but ammonia shows slight positive adsorption. Primary and; to a greater extent, secondary aliphatic amines are adsorbed, and primary aromatic amines and strong aromatic and heterocyclic bases are strongly adsorbed. Alkaloids of low molecular weight are adsorbed slightly, but those of high molecular weight exhibit zero or negative adsorption, although they lower the surface tension of water very considerably. Salts of inorganic acids and bases are adsorbed only hydrolytically, the acid alone being adsorbed, and, for salts of any one base, the order of such adsorption is that shown by the corresponding acids. For salts of surface-active organic acids (bases) with inorganic bases (acids), the adsorption is partly hydrolytic but mostly molecular. Salts derived from organic acids and bases, which are both surface-active, are adsorbed almost entirely molecularly. The essential factor in molecular adsorption is considered to be the polar character of surface-active organic acids and bases. T. H. P.

1998. Adsorption of Excess of Ions by Positive and Negative Sols of Silver Halides and Thiocyanate. A. Lottermoser and W. Petersen. *Zeits. f. phys. Chem.* 133. 1–2. *pp.* 69–121, *March,* 1928.

By potentiometric measurements of the concentration of the silver ions determinations have been made of the adsorption of the excess of silver, halogen and thiocyanate ions by positive and negative sols of silver halides and thiocyanate during their formation and by the hydrogels arising therefrom. The extent of the adsorption increases as the solubility of the salts diminishes, and the adsorption of bromine and iodine ions by negative silver bromide and iodide sols is considerably greater than that of silver ions by the corresponding positive sols. Although they are only slightly more soluble, negative silver thiocyanate sols exhibit considerably less adsorption towards thiocyanate ions than negative silver bromide ions do towards bromine ions. The occurrence of flocculation, the varying rapidity of the establishment of the adsorption equilibrium, shown in the inconstancy of the potential, and also the magnitudes of the potential changes at the equivalence point, express the degree of adsorption in its broad outlines. The accuracy of the potentiometric titration determined by the method used is subject to a limit lying in the change of potential at the equivalence point. For sols of silver thiocyanate, bromide and iodide it is the same and, with final concentrations of the silver halide of $\frac{N}{20}$ and $\frac{N}{110}$, amounts to ± 0·008 %, provided that constancy of the potential is assumed. Negative sols of silver chloride and bromide are particularly sensitive to light shortly before the equivalence point is reached and decompose appreciably. This phenomenon serves as the basis of a method for measuring the light-sensitiveness of these sols, the quantity either of the decomposed halide or of the halogen formed being measured. The sensitiveness towards light of the positive sols and of silver iodide sol does not influence the potential if the action of the light is not too prolonged. Silver iodide and bromide sols are decided colloidal electrolytes, with which the greatest part of the adsorption consists in a discharge of the sol. With the other sols, which are also to be regarded as colloidal electrolytes, the adsorption effected by discharge prior to flocculation is so slight that it escapes measurement. The silver thiocyanate and iodide hydrogels arising from the negative sols still adsorb a measurable quantity of silver ions when these are present in relatively large excess, whereas the other hydrogels, after the equivalence point is passed, adsorb only small amounts of the excess ions. T. H. P.

1999. Adsorption of Vapours on Charcoal and the Expansion due to Heat of the Wetting Layer. F. Goldman and M. Polányi.

Zeits, f. phys. Chem. 132. 5–6. *pp.* 321–370, *March*, 1928.

The paper is both of a theoretical and practical nature. Special importance is given to the potential theory of adsorption. A method is given for the determination of adsorption isotherms of vapours wherein the adsorbed quantity is determined by weighing in the liquid state, thus allowing great accuracy. The equilibrium weights are capable of sharp reproduction after months. The adsorption isotherms on charcoal are given for ethyl chloride, ethyl ether, *n*-pentane and carbon bisulphide at − 15·3°, 0° and + 20° C. (for *n*-pentane also at − 63·7° C. and 5·2° C.), and for equilibrium pressures from 90 % of saturation pressure down to $1 \cdot 10^{-2}$ mm. The apparent buoyancy of the given charcoal in the four mentioned liquids as well as in water and carbon tetrachloride is also given for temperatures at 0° C., and + 5·3° C., thus allowing the determination of the expansion due to heat of the wetting layer. The results, according to the authors, seem to indicate that the adsorption of vapours does not depend on capillary condensation—in fact, it is said that the potential theory of adsorption is sufficiently confirmed because the wetting quantities of different adsorptive materials are in ratio to their liquid densities for a given adsorbing material; the volume of the wetting layer remains constant during change of temperature; the expansion due to heat of the wetting layer of such adsorbed substances as ethyl chloride, ether and *n*-pentane is about 20 % smaller than for the liquid state, water, on the other hand, showing a positive heat expansion between 0° C. and 5° C.; for constant wetting affinity as a first approximation the layer x, and as a second approximation the adsorbed liquid volume $X/\partial fl$, are independent of the temperature; and the heat of wetting is greater than the wetting affinity, this in general decreasing with increase of the layer, though short of the saturation point there is a steep rise. J. K.

2000. Adsorption, Heat of Adsorption, and Character of Combination of Sulphur Dioxide with Charcoal in Small Coatings. M. Polányi and K. Welke. *Zeits. f. phys. Chem.* 132. 5–6. *pp.* 371–383, *March*, 1928.

According to this paper, adsorption isotherms and heats of adsorption of sulphur dioxide are studied for layers varying from a few ten-thousandths to 3 % of the maximum value, from the results of which work it is concluded that for very small layers (about 5 ten-thousandths of the maximum quantity) the adsorptive material is bound by forces of high energy value (20,000 cal.) within a narrow working range. For increase of thickness (about 5 to 8 ten-thousandths of the maximum quantity) the additional adsorbed quantity is bound with far less heat of adsorption, this falling to 6000 cal., but such a layer shows such great mobility that it can be considered as a two-dimensional gas, filling the adsorption space to a considerable part. With still further increase of adsorption (of about one- to thirty-thousandths of the maximum quantity) a condensed layer is produced. J. K.

2001. Adsorption from Solutions. (Adsorptive Material: Charcoal. Adsorbed Materials: Substances of Low Solubility.) W. Heyne and M. Polányi. *Zeits. f. phys. Chem.* 132. 5–6. *pp.* 384–398, *March*, 1928.

The results are given for three temperatures of a series of adsorption measurements with charcoal of a number of crystalline substances of low solubility from aqueous and alcoholic solutions. Though the adsorption figures for a given substance are lower when the substance is dissolved in organic solvents than when dissolved in water, and the adsorption of phenol at its melting point and beyond resembles the adsorption of fluid vapours, the presentation of the phenomenon according to the data obtained is uniform. If the isotherms are arranged in the form of curves of wetting affinity (affinity curves), the affinity curves shift towards higher values with increase of temperature, such displacement being far greater and in the inverse sense to the temperature displacement of affinity curves of liquid vapours. The maximum value of the adsorbed quantity (wetting quantity) also increases with the temperature contrary to that of vapours, the wetting quantity of which decreases with temperature increase. The absolute value of the affinity, and especially of the volume of the maximum adsorbed quantity (adsorption volume), is far smaller than for the adsorption of liquid vapours. These peculiarities are explained by the facts that in adsorption from solutions the solvent must be removed through the adsorbed material on the charcoal, and that work must necessarily accompany the " wetting reaction " (melting work) in order to destroy the crystal lattice. J. K.

2002. Chemical Dynamics in a Rigidly Coherent Phase. D. H. Bangham. *Phil. Mag.* 5. *pp.* 737–749, *April*, 1928.

Bangham and Burt [see Abstract 1590 (1924)] observed that equations of the form $S = \text{constant} \times t^{1/m}$ govern in many cases the rate of the sorption process, where S is the amount of gas accepted by the solid at time t, and m is a constant greater than unity. It is now found that the equations are widely applicable to processes involving the disturbance of the "inner equilibrium" of solid substances, provided the solid after-disturbance remains rigidly coherent. Calculations are made on certain hypotheses of the mode of variation during the progress of the reaction of the force restraining their thermal movements. It is shown that the index-constant of the "power"-time equation is given by the ratio $(V_A - V_2)$ $(V_1 - V_2)$, where $(V_A - V_2)$ is the difference of volume between the activated and final states of the atomic groups, and $(V_1 - V_2)$ the difference between the initial and final volumes. T. B.

2003. Density and Electrostriction of Dilute Manganese Salt Solutions. A. N. Campbell. *Chem. Soc., J. pp.* 653–658, *March*, 1928.

The expression $M(n^2 - 1)/d(n^2 + 2)$, where n is the refractive index for light of infinite wave-length, is supposed to represent the true molecular volume of a salt, so that to obtain this quantity the refractive indices of the dilute manganese salt solutions employed was determined, and the diminution of volume of the salt in dissolving was subtracted from the contraction of salt plus liquid; the remaining contraction was the contraction in the liquid, and the term electrostriction previously applied to the whole contraction was given to this portion of it. The method of Kohlrausch and Hallwachs was employed, and results are given for the chloride, sulphate and nitrate. Curves are given for the E.S., which show maxima for certain concentrations. These, as suggested by Baxter and Wallace, indicate two opposing processes, one of which preponderates on each side of the maximum. Calculations with the "true molecular volume" in the cases of the chloride and nitrate indicate a negative electrostriction, an expansion of the solvent. H. N. A.

2004. Hydrogen Overvoltage in the Case of Alloys. M. G. Raeder and J. Brun. *Zeits. f. phys. Chem.* 133. 1–2. *pp.* 15–30, *March*, 1928.

The object of this investigation has not been to determine exact values for the minimum overvoltage of alloys, but the practical displacements of the overvoltage within different alloy systems by means of current density potential curves. In the case of mixed crystals the overvoltage can be displaced regularly between the limiting values of the components, although appreciable increases above the normal values can occur. In eutectic systems the overvoltage is not determined by the components of lowest characteristic value, but appears to be a more or less uniform displacement between the values of the components. The data for the eutectic system P*b* — A*g* are so peculiar as to raise doubts as to the accepted structures for these alloys. In the system P*b* — S*b* the overvoltage data appear to confirm the thermal data indications of the existence of Pb_4Sb. The system S*b* — A*g* was characteristic of its component (S*b*) of highest overvoltage. The general results appear to indicate a sensitive method for the qualitative testing of structural alterations. H. H. Ho.

2005. Theoretical Potential of Sodium, Potassium and Calcium. P. Drossbach. *Zeits. f. Elektrochem.* 34. *pp.* 205–211, *April*, 1928.

In a previous paper the author calculated the potential of aluminium [see Abstract 2175 (1927)] and developed a method for calculating the potentials from thermodynamic data. Applying the method to the cases of sodium, potassium and calcium, the potentials were calculated. The results gave the values for sodium − 2·52 ± 0·02 volts; for calcium

− 2·39 volts; but a subsequent recalculation gave the value − 3·03 volts; for potassium the value − 2·72 ± 02 volts was obtained. F. J. B.

2006. Experimental Technique for the Quantitative Study of Photochemical Reactions. G. S. Forbes. *J. Phys. Chem.* 32. *pp.* 482–502, *April*, 1928.

The paper forms a selective and critical review of the experimental methods employed in photochemical investigations. The subject matter includes light sources, in which sources with continuous and discontinuous spectra are considered. The quantitative measurement of radiation intensity is discussed. The production and use of monochromatic light is described. Stirring of the reaction mixtures, temperature regulation, dark reaction velocity, calculation of results, analytical methods, and reaction vessels are critically examined. A critical selection of the important papers is given under each section. F. J. B.

2007. Absorption Coefficients. H. G. de László. *J. Phys. Chem.* 32. *pp.* 503–506, *April*, 1928.

The theory of and methods of determining absorption coefficients is considered. The various methods for varying the intensity of the light are discussed. The use of sectors, wire screens and different designs of spectrophotometers is described. The application of the photoelectric cell and microphotometer is outlined. The significance of the absorption coefficients of vapours and gases and the methods for determining them are discussed. F. J. B.

2008. Excited Systems Formed by the Absorption of Light. L. A. Turner. *J. Phys. Chem.* 32. *pp.* 507–515, *April*, 1928.

The fundamental law of Grotthuss and Draper, *viz.*, that the only radiation which will produce a photochemical reaction is that which is absorbed by the reacting system, is examined from the standpoint of the modern atomic theory, and from the structure of the atom. The results are discussed and their bearing on photochemical reactions is indicated. The important papers dealing with this subject are given in a list of references. F. J. B.

2009. Quantum Processes in Photochemistry. H. S. Taylor. *J. Phys. Chem.* 32. *pp.* 516–528, *April*, 1928.

The quantum theory is applied to photochemical processes, and the analogy between electrochemical and photochemical processes is developed and illustrated. The conception of the non-absorbing components of a photochemical system as "depolarisers" is examined. The reaction between hydrogen and iodine, hydrogen and chlorine, hydrogen and bromine is discussed, and it is shown that the high yield in the hydrogen-chlorine reaction is due to the setting up of a reacting system containing atomic chlorine, due to the process of light absorption. From consideration of photosensitised processes, illustrated by excited mercury as a sensitiser, and the photosensitised decomposition of ozone, and from a discussion of the stationary state, inhibition, complex photo-processes, such as oxidation of quinine, reduction of Fehling's solution, and from Einstein's law of photochemical equivalence, two laws of photochemistry are deduced. The first is the Grotthuss-Draper absorption law, while the second can be stated thus: The absorption of light is a quantum process involving one quantum per absorbing molecule (or atom). The photochemical yield is determined by the thermal reactions of the system produced by the light absorption. F. J. B.

2010. Displacement of Equilibrium by Light. W. D. Bancroft. *J. Phys. Chem.* 32. *pp.* 529–572, *April,* 1928.

The general groundwork and underlying principles of the chemical action of light are discussed. A very large number of reactions which are brought about by light, and the conditions necessary for the reactions to take place, were considered. It was shown that so long as reversible equilibrium alone was dealt with the theory of displacement of equilibrium by light was simple. The conditions necessary were that a photochemical change takes place and that the rate of the photochemical change must be greater than the sum of the rates of the reverse reaction in the dark and in the light. The rate of the reverse reaction can be considerably increased in the dark by raising the temperature, hence the amount of displacement of equilibrium by any given light usually decreases with the rise of temperature. F. J. B.

2011. Relation between Photochemical and Ionisation Reactions. S. C. Lind. *J. Phys. Chem.* 32. *pp.* 573–575, *April,* 1928.

It has been found that the yield per quantum in light reactions often exceeds that predicted by Einstein's law by very large amounts. The reaction between hydrogen and chlorine can be brought about by light for the production of the quanta, and α radiations for the generation of ions. Examination of the two reactions showed that each chlorine ion (positive or negative) produced about twice as many HCl molecules as one light quantum (blue). The examination of a number of reactions which can be compared in a similar way showed that there is great need to critically examine more reactions by both means of activation, ionisation and excitation under identical conditions before it can be stated how far the parallel between $M/h\nu$ and M/N will extend. F. J. B.

2012. Differential Equations of a Reacting Mixture. R. D. Kleeman. *Phil. Mag.* 5. *pp.* 620–629, *March,* 1928.

In an earlier paper [see Abstract 1329 (1928)] it has been shown on thermodynamical reasoning that the constant of mass action, K, may in general not be a constant and that in this case there must exist a system of differential equations connecting it with the volumes and masses of the reacting substances and the temperature. In this paper the equations are derived and applied to certain reactions. A. Wh.

2013. Mechanism of Some Luminous Chemical Reactions. Part II. V. Kondratjew. *Zeits. f. Phys.* 48. 5–6. *pp.* 310–322, 1928.

This paper continues previous work [see Abstract 482 (1928)] on the reactions between alkali metals and vapours of various salts. It is now shown that the reactions between $CuCl_2$ and $CuBr_2$ and the alkali metals at relatively low temperatures is analogous to the reaction $HgCl_2 + Na$ at the solid surface. The spectra emitted by these reactions appear identical with those of CuCl and CuBr. The calculation of the energy balance shows that the existence of these spectra may be explained by the accepted mechanism of surface reactions. The volume reaction between Na and $HgCl_2$ is thoroughly investigated and its mechanism discussed on the basis of new facts. Conditions for the transition from volume to surface reactions are investigated. H. H. Ho.

2014. Studies in Photosensitisation. Part II. A Source of Cadmium Resonance Radiation. J. R. Bates and H. S. Taylor. *Am. Chem. Soc., J.* 50. *pp.* 771–773, *March*, 1928.

The authors describe an attempt to extend the field of photosensitised processes to include other metallic vapours than mercury. The resonance data and volatility of zinc, cadmium and mercury are compared. It is shown that cadmium and zinc have advantages over that of mercury, this being especially so for cadmium. The paper deals with the effect of cadmium atoms in the 2^3P_1 state (3262·1 Å.) on ammonia and hydrogen-ethylene mixtures, ammonia and probably hydrogen being unaffected, whilst ethylene is polymerised, results in agreement with the theoretical considerations of the reactions. A new type of cadmium quartz lamp is described wherein a 50 % cadmium-tin alloy is employed. [For Part I see Abstract 486 (1928).] J. K.

2015. Quantum Theory of Quasi-Unimolecular Gas Reactions. O. K. Rice. *Nat. Acad. Sci., Proc.* 14. *pp.* 113–118, *Feb.*, 1928.

Hinshelwood's quasi-unimolecular reactions [see Abstracts 824 and 1936 (1927)] are unimolecular at high pressure, but fall off in rate at low pressures. Rice and Ramsperger [see Abstract 3008 (1927)] assumed that either, theory I, each collision of an activated molecule resulted in deactivation, or, theory II, the fraction of molecules reacting in unit time was proportional to the fraction of molecules of energy ϵ, in which a certain squared term in the energy expression for the molecule exceeded the value ϵ_0. The energy expression consisted of a sum of squares of coordinates and momenta, and the calculations were made on the methods of classical mechanics. In this paper theory II is discussed for quantised molecular motions. The number n of the squared terms (coordinates and momenta) stands for the degrees of freedom, and n is evaluated by multiplying the number of atoms in the molecule by six (each molecule having three coordinates and three momenta) and subtracting nine (six because the coordinates determining the orientation of the molecule as a whole do not affect the total energy, and three more because the translational energy of the molecule does not affect the chance of reaction); thus n will be equal to C_v expressed in calories. The ϵ_0 is now determined as the difference between the average energy of the molecules which react and the average energy of all the molecules after Tolman's statistical mechanics. The paper is purely mathematical. All the quantities are evaluated in terms of the thermal properties of the decomposing molecules. H. B.

2016. Theory of the Decomposition of Azomethane. O. K. Rice. *Nat. Acad. Sci., Proc.* 14. *pp.* 118–124, *Feb.*, 1928.

The decomposition of azomethane is studied in connection with the preceding paper as a case of a homogeneous gas-phase reaction, unimolecular at high pressure. For the estimation of the quantities the thermal properties of azomethane, particularly the energy at the temperature of reaction, 600° C. abs. and at higher temperatures, are deduced by comparison with the similar compound acetone. Assuming an average specific heat of 0·5 for azomethane, and that a harmonic oscillator which is excited 0·5 as regards specific heat has 0·15 of the classical energy value (Einstein), the average energy would be about 4500 gm. cal. at 600° C. abs. and 56,500 cal. per mole at 1900°. The paper discusses the chances that the necessary energy is attained in activation by collision, and that it is localised in a particular portion of the molecule. Another explanation might be possible on the hypothesis of the chain reaction of Christiansen and Kramers. On that assumption the reaction rate should fall off as the reaction products accumulate, which is observed only to a very slight extent; photochemical considerations also indicate that chain reactions do not play a very important part in the thermal case. H. B.

2017. Unimolecular Gas Reactions at Low Pressures. Part II. Azomethane. O. K. Rice and H. C. Ramsperger. *Am. Chem. Soc., J.* 50. *pp.* 617–620, *March,* 1928.

Deals with the same problems first studied [see Abstract 3008 (1927)] in the case of propionic aldehyde. Azomethane [Ramsperger, *ibid.* 49. pp. 912–916, 1927] is a colourless gas condensing to a pale yellow liquid boiling at + 2° C.; it explodes at red heat and also under the action of electric sparks, the $CH_3 . N : N . CH_3$ yielding C_2H_6, N_2 and other products. The decomposition is observed at initial pressures between 0·02 cm. and 71 cm. and temperatures between 276 and 330° with varying glass areas; the pressures increased to about three times initial value. The heat of activation was only at first calculated from the Arrhenius equation of temperature coefficients. Theory I does not fit at all. Theory II seems applicable; the number of degrees of freedom is 25. In the case of diethyl ether, theory II fits a little better than I, and would require only 6 degrees of freedom. H. B.

2018. Kinetics of the Dissociation of Diatomic Molecules. J. Frenkel and N. Semenoff. *Zeits. f. Phys.* 48. 3–4. *pp.* 216–230, 1928.

On the basis of the principle of perfect equilibrium, the relative parts played by impacts and by radiation of heat in activating atoms and molecules are determined. Further, the reaction $A_2 = A + A'$ accompanying the activation is decomposed into partial reactions, the relation between the velocity coefficients of the opposed reactions is determined according to the above-named principle, and the kinetics of the total reaction for its initial phases is developed. For purposes of comparison the impact dissociation occurring without activation, and the catalytic dissociation conditioned by adsorption are also considered. Results are arrived at which are in agreement with the view that it is almost impossible to dissociate a molecule by increase in the kinetic energy of the two atoms. This kinetic energy is transformed into energy of the electrons, which finally pass into higher quantum paths. It is, therefore, easier by impacts to bring a molecule A_2 into an activated state than to dissociate it.

T. H. P.

2019. Critical Study of the Experimental Investigations on the Heat of Formation of Liquid Water and of Carbon Dioxide. M. W. Travers. *J. Inst. F.* 1. *pp.* 279–287, *April,* 1928.

The inaccuracies involved in the experimental methods employed in some of the classical investigations on the heats of combustion of hydrogen and carbon are pointed out, and the necessity emphasised of settling the value of the relationship between the mean calorie and the 15°-calorie. The conclusion is reached that the heat of formation of liquid water is 68,485 15°-calories at 0° and 68,345 15°-calories at 18°, but it is admitted that there remains an element of uncertainty which makes redetermination desirable. For well-carbonised coke the value 94,750 15°-calories appears to be the average value of the molar heat of combustion. T. H. P.

2020. Reversibility of a Reaction Provoked by Electric Sparks or Currents. P. Jolibois, H. Lefebvre and P. Montagne. *Comptes Rendus,* 186. *pp.* 948–950, *April* 2, 1928.

Previously the limited dissociation by continued electric sparks of CO_2 at low pressures and the relation between such dissociation and dissociation by heat have been studied [see Abstract 1210 (1927)]. Further experiments have shown that the limiting value of the degree of dissociation of CO_2 is the same as the limiting value of the degree of combination of CO and O for equal final pressures, either when using continued electric sparks or direct current. It is deduced that sparks and currents exercise a dual function in chemical reactions, (1) as a catalytic agent to render unstable systems stable, (2) as a carrier of energy to make a stable system less stable. It has also been found that the action of the spark or current is gradual; for the same expenditure of energy a greater degree of combination is reached with a weak direct current or weak sparks than with sparks obtained by discharging a large condenser. Numerical results are given. M. v. H.

2021. Electrical Solution-Mixing Device. K. Hickman and D. Hyndman. *Indust. and Eng. Chem.* 20. *pp.* 213–216, *Feb.* 1, 1928.

The authors describe an electrical titrating or solution-mixing apparatus wherein external gaseous indicators such as sulphur dioxide or ammonia are employed, these, when dissolved in water, being capable of detection by an electric " nose " placed over the reacting vessel, and the current variations thus produced actuate a valve which limits the particular solution in excess at that moment. It is not necessary for a volatile material to be directly evolved from a reaction. In the common reaction $H_2SO_4 + 2NaOH = Na_2SO_4 + 2H_2O$ ammonia may be added in minute quantities to either solution and, being a weak base, will be the last to be neutralised, and thus provides the necessary indicator vapour. For working on the acid side a trace of sulphite can be added to the alkaline reagent, sulphur dioxide being evolved on acidity. Several applications of the principle in question are described. J. K.

2022. Transition Cells of the Sixth Class. E. Cohen and E. J. Joss. *Am. Chem. Soc., J.* 50. *pp.* 727–733, *March,* 1928.

Transition cells of the sixth class consist of cells containing a depolariser which possesses a transition point. In the present case the depolariser was silver iodide. A series of e.m.f. measurements were made in a cell, constructed of glass, with a lead and a silver electrode and a saturated solution of silver and lead iodides in calcium chloride as electrolyte. The cell was heated over a range of temperature in a thermostat, which could be maintained at the desired temperature to within 0·1° C. Temperature-e.m.f. measurements showed that the transition temperature of silver iodide was 146·6° C. The heat absorbed during the transition of one mol. of AgIα into one mol. of AgIβ, calculated from the temperature-e.m.f. curves was 1270 cal. F. J. B.